FORAGE INVENTORY
OF THE
CHUNGO-CLINE-NORDEGG STUDY AREA

by

Rhonda L. Wehrhahn

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T/19 - No. 2 Forage Inventory of the Brazeau-Pembina Study Area

T/19 - No. 3 Forage Inventory of the Rocky-North Saskatchewan Study Area

ABSTRACT

An inventory of forage was undertaken in the Chungo-Cline-Nordegg Study Area during the summer and fall of 1981. The purpose of this inventory is to provide basic data related to the forage resource. The objectives are to describe and classify the vegetation, to determine the annual yield of herbaceous forage and palatable browse, and to prepare a forage map at a 1:50 000 scale.

Species composition and biomass were tabulated for 22 of 24 forage types which occur in the Chungo-Cline-Nordegg Study Area. Four ecoregions occur in the study area, of which the Subalpine Ecoregion is the largest.

Native forage consists of a wide variety of shrubs, forbs, and grasses. Variation in biomass is evident among and within the forage types. The yield of herbaceous forage is highest in the dry brushland and grassland types with the exposed rock areas being devoid of vegetation.

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1. INTRODUCTION

Alberta Energy and Natural Resources is responsible for the orderly development and wise use of our renewable resources. To ensure this, the department has adopted a policy of integrated resource management. Fundamental to this is the preparation of an integrated resource management plan that gives full consideration to all possible uses of the land. In order that the plan be based upon sound knowledge, inventories of all aspects of the resources of the area are conducted. A forage inventory was one of a number of resource inventories carried out in the Chungo-Cline-Nordegg Study Area.

In order to manage range resources in a manner that ensures sustained forage yield and compatibility with other land uses, a good knowledge of the quality and extent of the grazing resource is required. The forage inventory provides this information at a reconnaissance level. The study provides information on potential areas for grazing by domestic cattle and ungulates. As well, the study identifies high-priority areas where more intensive surveys should be initiated.

The forage inventory of the Chungo-Cline-Nordegg area was initiated in 1981 as part of the continuing program by the Resource Inventory Section. The objectives of this inventory were to identify and describe major forage types, and to determine the yield of herbaceous forage. The provision of base-line data will allow the various resource management agencies to interpret the information, which, when combined with other resource utilization input, can lead to the formulation of sound land-use decisions.

2. STUDY AREA

2.1 Location and Extent

The Chungo-Cline-Nordegg study area covers about 3 900 km^2 in the west-central portion of Alberta (Figure 1). The area lies between 116^o and 117^o west longitude and between 51^o 55' and 52^o 55' north latitude. It is bounded by forest management units R2 and R4 to the east and the Banff-Jasper National Park Boundary to the west. The study area includes all or parts of Township 34-45, Ranges 14-21, West of the Fifth Meridian. The study area represents R3 and R6 forest management units of the Rocky-Clearwater Forest.

2.2 Ecological Regions

The term ecoregion can be defined as "an area characterized by a distinctive regional climate as expressed by vegetation" (Subcommittee on Biophysical Land Classification, 1969). This definition has been derived from the fact that vegetation responds to different regional climates by altering species composition, physiognomy, and successional patterns.

The major climatic regimes -- Prairie, Cordilleran and Boreal -- are modified by factors such as latitude, elevation, continentality, and storm tracks to create 12 ecoregions in Alberta (Strong and Leggat 1980). These ecoregional climates are represented by both abiotic and biotic factors.

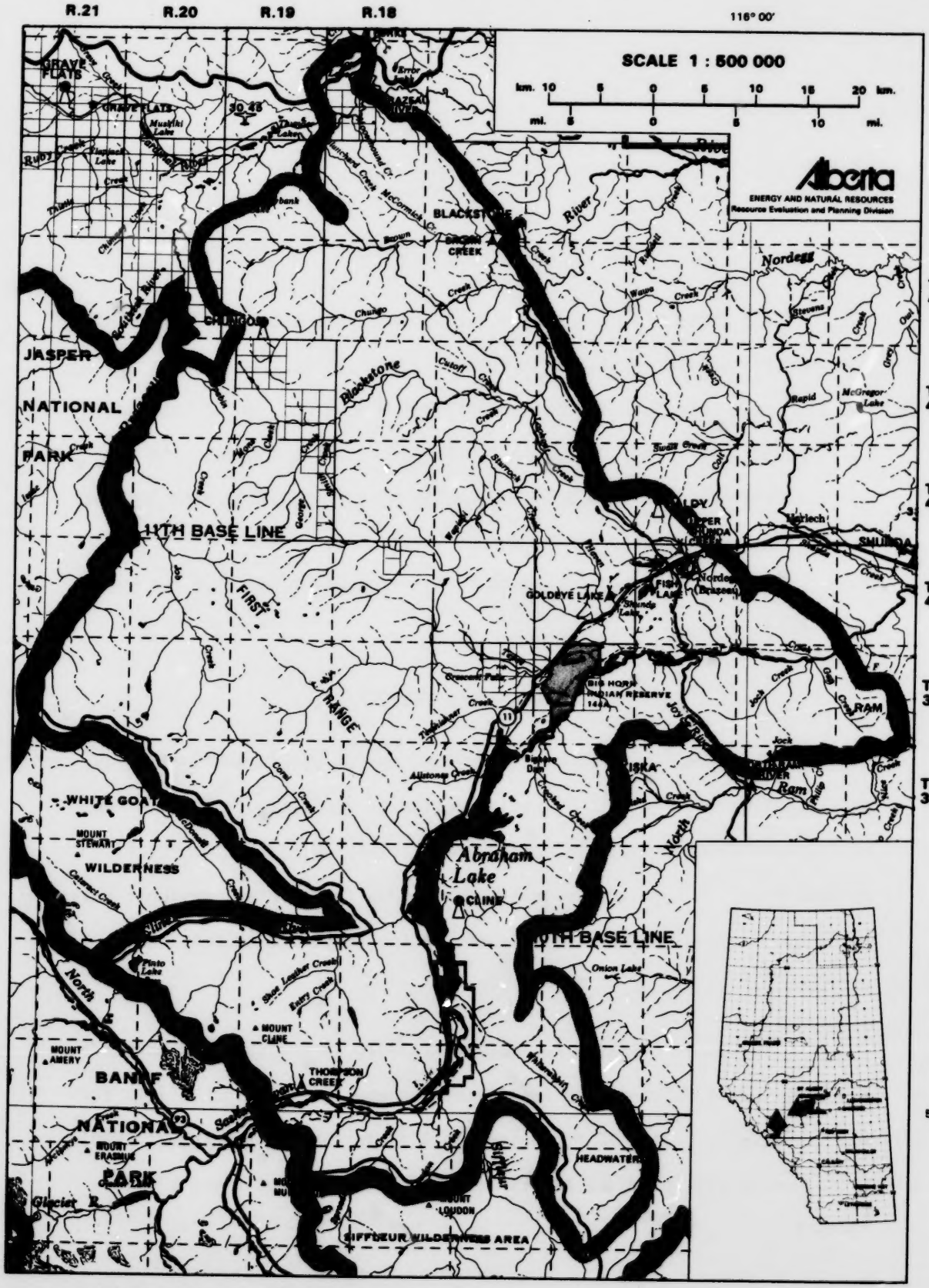


Fig. 1 CHUNGO - CLINE - NORDEGG STUDY AREA

Four ecoregions have been described by Strong and Leggat (1980) in the Chungo-Cline-Nordegg study area. These are the Boreal Uplands, Subalpine, Alpine, and Montane. These are the first major divisions of the study area in the study of vegetation.

Boreal Uplands

The Boreal Uplands Ecoregion, referred to as Ecoregion 10, occupies the eastern portion of the Chungo-Cline-Nordegg study area (Strong and Leggat 1980). Elevationally, it occurs below the Subalpine and above the Boreal Foothills Ecoregion. Both mountain and foothill topography are associated with the area.

The boreal climate of the uplands is substantially modified by the Rocky Mountains. Cool summer temperatures and ameliorated winter temperatures express this Cordilleran influence. The mean May-to-September temperature is 10.0°C,with a range of 8.5 to 11.5°C. The mean May to September temperature of 11.0°C corresponds very closely with the boundary between the Boreal Foothills and Boreal Upland Ecoregions. The freeze-free period ranges from 105 to 20 days.

The precipitation regime is continental as all available stations receive more than 55 percent of their annual precipitation during the May-to-September period. The mean yearly precipitation is 570 mm,with a range of 440 to 740 mm.

Lodgepole pine dominates the overstory vegetation on moderately

well-drained substratum in the Boreal Uplands Ecoregion. The cool climate severely restricts the growth of deciduous species such as aspen and balsam poplar. Secondary succession is to white and black spruce. The understory vegetation is relatively non-diverse due to the cool mesoclimate and cool microclimate created by the tree canopy.

Imperfectly-drained areas are dominated by lodgepole pine with a successional trend to black spruce. Mosses and ericaceous shrubs are common in the understory.

In areas of poor drainage, black spruce dominates the overstory vegetation. Poor drainage and low oxygen availability result in organic accumulations. These areas commonly have an understory of moss and Labrador tea, indicating acidic conditions and low nutrient availability.

Well - to rapidly well - drained sites are characterized by open stands of lodgepole pine dispersed among scattered grasses and shrubs. These sites generally occur on exposed south-facing slopes.

Subalpine

The Subalpine Ecoregion, referred to as Ecoregion 6, is an altitudinal vegetation zone with the upper boundary formed by the Alpine Ecoregion and the lower boundary abutting the Montane, Aspen Parkland and the Boreal Uplands Ecoregions.

The Subalpine Ecoregion has a Cordilleran climate characterized

by snowy, cold winters and showery, cool summers. The high precipitation, relative to that in the Boreal Uplands Ecoregion, is due to the increased influence of Pacific air masses which are warmer and more moist than Arctic air masses that dominate further to the east during winter.

Mean annual precipitation in the Subalpine Ecoregion is 720 mm, but there is a wide range, from 350 to 1 230 mm. An average of 49 percent of the yearly precipitation occurs during October to April. Not only are precipitation totals greater, but precipitation events are much more frequent.

The mean May-to-September temperature in the Subalpine is 9.5°C. Elevational effects on temperature in this ecoregion are important. During summer, daytime temperatures in subalpine valleys are higher than on valley slopes. This trend is often reversed at night, however, as cold air drains into the valley bottom, making it much cooler than on the valley slopes.

Cool conditions are also reflected in the small accumulation of growing degree days, ranging from 710 to 930.

A mean climatic moisture deficit of 110 mm for this ecoregion may be misleading, as temperature data in this ecoregion is limited. Much of this ecoregion actually has a large climatic moisture surplus.

The Subalpine Ecoregion can be divided into three protions: the Pine, Spruce-Fir, and Upper Subalpine Ecoregion.

The Pine Subregion is a zone of lodgepole pine which shows little evidence of succession to Engelmann spruce and/or alpine fir in the first 100 or more years of stand growth. This zone occurs at the lowest elevation of the Subalpine Ecoregion. The Pine Subregion may be too xeric for typical spruce-fir succession. It may also be influenced by the lack of spruce seed caused by frequent fires.

The Spruce-Fir Subregion is located altitudinally above the Pine Subregion. Forests of this area differ from the previous subregion by displaying evidence of spruce-fir succession in the early stages of stand development. Moisture is more abundant in the Spruce-Fir Subregion than in the Pine Subregion.

The Upper Subalpine Subregion is characterized by open-canopied vegetation that occurs between the Spruce-Fir Subregion and climatic forest-line of the upper elevational limit of continuous tree growth. Plant growth is retarded in this zone due to low temperatures, high wind, moisture stress, and the short growing season.

Scattered throughout the Subalpine Ecoregion are grasslands. These grasslands typically occur on steep south-facing slopes where solar insolation and evapotranspiration are very high.

Alpine

The Alpine ecoregion, referred to as Ecoregion 7, occurs above climatic forest-line in the Rocky Mountains. It is situated above the

Subalpine Ecoregion. Forest-line is defined as the zone in which contiguous forest stops and isolated islands of trees begin (Ogilvie, R.T. 1976). Elevationally, the Alpine occupies terrain above 2 000 m in this portion of the province.

This ecoregion has a more severe Cordilleran climate than the Subalpine. The overriding climatic elements which characterize the Alpine are strong winds, long winters, and cool summers. Below-freezing temperatures are common even during the warmest months. Precipitation is high during all months with a tendency for greater precipitation during winter. As there is no overstory vegetation, the surface displays a highly variable microclimate. During summer, the climates of steep south-facing slopes differ markedly from those of north-facing slopes. During winter, southwest - to northwest-facing slopes may be completely snow-free whereas east aspects or protected pockets may have snow cover several metres deep which may last well into summer, or even year-round.

The range in Alpine mean annual precipitation is not as great as that in the Subalpine, but the mean is very similar at 730 mm. The mean May to September precipitation is 360 mm which is 40 mm higher than in the Subalpine Ecoregion. The range in summer Alpine precipitation is 270 to 430 mm. A mean of more than 50 percent of the total annual precipitation occurs during October to April. The mean precipitation for this period is 400 mm, which is very similar to that in the Subalpine. Although snowfall is high in the Alpine, snow cover distribution is highly variable.

From long-term climate stations in the Alpine, a mean summer temperature of 6.5° C was calculated with a range of 4.0 to 7.5° C. Low mean summer temperatures set the Alpine apart from all other ecoregions. The occurrence of freezing temperatures in the Alpine is spatially variable. Exposed south-facing slopes may have freeze-free periods in excess of 25 days, but depressions and protected areas may be limited to freeze-free periods of only several days in length. Growing degree day accumulation above 5.0° C is very small in the Alpine. It is likely that fewer than 500 degree days are accumulated, but this will depend on slope angle and orientation.

Mean January temperatures are approximately -15.0° C. This ecoregion does not experience "chinooks", and temperatures rarely, if ever, go above 0° C during the December to February period. Snow depth can vary from zero to several metres, and may last from a few days to years.

In the Lower Alpine, willow and dwarf birch communities and islands of krumholz occur. The Middle Alpine is characterized by relatively continuous heather and snowbed communities, while the Upper Alpine is poorly vegetated due to the cool summer temperatures and exposure to wind. Rocky outcrops and stonefield lichen communities are typical of the Alpine Ecoregion. Glaciers occur in the highest terrain where snow accumulation exceeds ablation.

Such species as heathers, dryad, and kobresia typify the Alpine Ecoregion.

Montane

The Montane ecoregion, Ecoregion 5, is restricted to foothills and major valleys of the Rocky Mountains. Elevationally, the Montane occurs below the Subalpine and above the Fescue Grass and Aspen Parkland Ecoregions.

The Montane Ecoregion displays both Cordilleran and Prairie climatic influences in Alberta, with eastern portions and lower elevations more continental in character.

Yearly precipitation totals range from 280 mm to 810 mm with a mean of 560 mm. However, precipitation totals below 400 mm are characteristic of the Kootenay Plains, which is associated more closely with those of the grassland ecoregions.

The mean May to September temperature is 11.0^{o} C. The most significant climatic characteristic that distinguishes the Montane from other ecoregions in Alberta is winter temperatures. The warmest mean December to February temperature (-7.5^{o} C) occurs in the Montane. Chinook activity and the reduced influence of cold Arctic air contribute to these warmer conditions.

Ecological conditions in the Montane Ecoregion are a result of its complex topography, small size and marginal adaptation to Alberta's climate.

Open stands of Douglas fir typify the common vegetation community

in most Montane areas. However, in this particular study area, limber pine is the characteristic species. Limber pine tends to occur where sandstone outcrops have formed steep ridges that are rapidly drained and have thus produced large moisture deficits.

Microclimatically and edaphically dry sites are characterized by grassland vegetation. These grasslands are usually associated with steep south-facing slopes or coarse-textured soils.

Moist and cool sites, such as north aspects, are occupied by aspen and lodgepole pine with white spruce and Douglas fir as common invaders. Increased moisture availability for plant growth results from reduced evapotranspiration.

2.3 Physiographic Regions

The Chungo-Cline-Nordegg area lies within the Rocky Mountain Foothills and the front ranges of the Rocky Mountains. The altitude in the northern part of the area is about 1 310 m (4 300 ft.) along the Brazeau River but increases to about 3 500 m (11 000 ft.) in the Rocky Mountains.

All prominent topographic features in the area are related to the structure and lithology of the underlying bedrocks and their differential resistance to erosion.

The study area was apparently covered by an ice-sheet during the early Wisconsin glaciation. The glaciers originated along the continental divide and were probably channeled into the North Saskatchewan and Cline

River valleys. Glacial depositional features are of minor importance in the Rocky Mountain region.

Based on major differences in elevation, relief, and structural geologic form, the study area is divided into two physiographic regions: Rocky Mountain Foothills region and Rocky Mountain region.

Rocky Mountain Foothills

This region covers the northern part of the study area and consists of steep, approximately parallel ridges which are oriented in a northwestern to southeastern direction. Elevation increases from 1 300 m (4 300 ft.) along the Brazeau River to about 1 890 m (6 200 ft.) on the Bighorn Range.

The foothills region of the study area is underlain mainly by non-marine, thick-bedded sandstone, sandy shale, and block gray mudstone belonging to the Brazeau Formation of Cretaceous age.

The principal surficial deposits found in this region are saprolite and till, with minor amounts of recent fluvial deposits and fluvial fan, colluvial, and organic materials.

The soils of the foothills are dominantly well-drained brunisols developed on saprolite or till material. Brunisolic soils developed on saprolitic parent material are confined to the steeply sloping areas where landform is strongly controlled by the underlying bedrock.

Brunisolic soils developed on till material are found on the lower slopes of hills and along the stream valleys. Regosolic soils prevail on recent fluvial and fluvial fan deposits, and on colluvium. These soils indicate weak development as a result of disruption, or immaturity, or both. Organic soils, usually mesisols occur in poorly-drained areas along the stream courses.

Rocky Mountain Region

This region represents the front ranges of the Rocky Mountains and consists of a series of sub-parallel, west-dipping thrust blocks which trend northwest, parallel to the trend of the outlier Bighorn Range. Elevation ranges from 1 550 m (4 700 ft.) along the North Saskatchewan River to over 3 600 m (11 000 ft.) at the mountain peaks.

The Rocky Mountains region is underlain mainly by Paleozoic formations. The rocks are dominantly limestones and dolomites with minor amounts of sandstones, siltstones, and shales. The region is dominantly barren rock and mass-wasting processes are active throughout the area. Surficial deposits, consisting of till, saprolite, recent fluvial and fluvial fan materials and colluvium, are found only in major valleys and on lower mountain slopes. Both the North Saskatchewan and Cline River valleys are entirely covered with till and fluvial deposits.

The soils of the Rocky Mountain region are dominantly well-drained eluviated eutric brunisols. Soils developed on recent fluvial and fluvial fan materials, and on colluvium indicate little or no profile.

development and are classified as regosols. In barren areas, soils are of limited occurrence and are simply composed of coarse-textured colluvium with some talus and scree materials. These soils grade to lithosolic soils which have a thin (less than 15 cm) soil layer consisting of some organic material resting directly on bedrock.

3. METHODOLOGY

3.1 Guidelines

The purpose of the forage inventory is to establish the types of vegetation communities, including cover estimates of species and productivity that occur within the study area.

The guidelines developed by the Forage Inventory Unit provides for the systematic delineation of land areas using ecological criteria. These guidelines are based on the principles of: recognizing the geomorphic nature of the earth's surface, recognizing the different climatic zones, and being aware of the interactions and influences of these on vegetation.

Information from other resource inventory groups is collected and studied to provide background data to the forage inventory. This information includes: physical land data from the Land Classification Group, ecological land classification data from the Resource Appraisal Group, and forest cover data from the Phase III Forest Inventory Group.

The study area is stratified using ecological parameters that can be identified on small-scale photography (1:60 000). Field plot locations are selected, prior to field sampling, on large scale photography, to obtain representative samples of plant communities as they occur under different site conditions. The number of sample sites allocated to each type is based on the relative importance of that type and variation

expected within the type. For example, a large number of sites are selected in brushland areas due to their importance for grazing and due to the high variability found in them. Occasionally, access to certain areas is limited, alpine communities in particular. It is therefore only practical to attempt minimal sampling in these areas.

Previously stratified areas are sampled for species composition and cover as well as productivity. Revisions of forage types are made and additional areas to be sampled are included in the stratification throughout the field season, as plot information is gathered. See Appendix 2 for plot location.

3.2 Field Sampling

At each field site a 5 m^2 plot is established to determine species composition and cover of shrubs. Specific cover values, by percent, are assigned to each species.

In addition, a 20 m transect with five .5 m^2 plots is established to determine presence and cover by percent of forb, grass, moss, and lichen species.

Plant species are listed in the field forms according to the layer in which they occur:

The breakdown of layers is as follows:

A_1 - overstory tree species

A_2 - understory tree species greater than 5 m tall

B_1 - shrub species - 2.5 to 5 m

B_{2a} - shrub species - .5 to 2.5 m

B_{2b} - shrub species less than .5 m

C - forb species

D - grass and grass-like species

Eb - moss species

El - lichen species

Other information collected includes: elevation, slope, aspect, shape of slope, microrelief, site disturbance, forest cover type, age, height of forest stand, and general comments about the site.

Biomass data for forbs and grasses are collected at pre-established plots at the height of the growing season. This involves clipping the current year's growth on the same transect as described for species composition and cover. The clips include all parts of plants whose stems originate in the plot, including all above ground parts that extend beyond the plot boundary. Excluded are all parts of herbaceous plants whose stems originate outside the plot, even though their foliage may overlap into the plot. This material is then air-dried and weighed, and the weight converted to kilograms per hectare.

Palatable browse biomass is also determined on these pre-established plots at the end of the growing season (Appendix Y). A 20 m x .5 m transect is established. Twigs occurring on stems between .5 and 2.5 m

above ground, are counted. Note: current year's growth over 2.5 cm constitutes a twig. These maximum and minimum heights were chosen as the former represents the average snow depth and the latter represents the maximum height the animals can browse. The browse biomass data therefore, represents available browse in winter. Twigs are clipped on every second plant of each species. Six twigs are clipped from each of these plants; two twigs from the bottom, middle and top third of the plant.

3.3 Data Analysis

The plot data is grouped by species composition as well as by physical and ecological factors, i.e. plots having similar species presence and cover values that occur in similar ecological areas are grouped to define a forage type. The mean cover values, frequency of species occurrence and prominence index (pi = mean cover $\times \sqrt{\frac{\%\ \text{frequency}}{100}}$) are calculated. The prominence index adjusts cover percentage by frequency of occurrence and therefore is used to determine the relative importance of each species within the community.

All plant species, with a prominence index of 0.5, are listed by vegetation layer in the accompanying appendices. Species with a prominence index 0.5 are listed at the bottom of the page.

Only those plant species occurring in the understory and with a prominence index 1.0 are listed in the accompanying tables. These are not lited by vegetation layer but rather are separated into woody and herbaceous species.

Biomass values for forbs, grasses and palatable browse are averaged for plots within each forage type.

3.4 Mapping

Mapping is initiated on aerial photographs with the aid of forest cover and geomorphic maps. The map units are delineated on the basis of the previously stratified areas and the ecological relationships established through field sampling.

Each unit is assigned a forage type symbol. Any unit may contain a percentage of two different forage types. An example of a mapping symbol is as follows: $Sb_1^{7} - B_1^{3}$. This represents an area with 70 percent of forage type Sb_1 and 30 percent of forage type B_1. Maps at a scale of 1:50 000 are produced as part of this study to show the areal distribution and location of each forage type.

4. RESULTS AND DISCUSSION

Mountain vegetation is extremely variable. The climatic variability which is responsible for this is due mainly to elevation and aspect. Other factors, such as winds and rain shadow effects, are modifying influences and are locally important. Aspect is probably the most important single factor, with marked differences between northern and southern exposures. Aspect affects insolation, hence evaporation, and therefore plays a major role in determining the humidity of a site. This, in turn, affects vegetation and soils (Pettapiece 1971).

The Chungo-Cline-Nordegg study area is, for the most part, characterized by a vegetative climax of white spruce, Engelmann spruce or a hybrid of the two species, with alpine fir. Only small areas of spruce-fir forest are present, occurring on generally cool, moist, north-facing slopes or at relatively high elevations. These are generally mature stands. Lodgepole pine dominates the majority of sites at lower elevations on a variety of aspects due to fire disturbance.

4.1 Pine Forage Types

The study area has an extensive fire history, resulting in the dominance of lodgepole pine. In fact, the majority of the study area consists of virtually pure stands of lodgepole pine with lesser amounts of mixed pine-spruce stands.

Eight pine forage types occur in the study area: Pine-Hairy Wild

Rye, Pine-Labrador Tea-Feathermoss, Pine-White-flowered Rhododendron-Feathermoss, Pine-Canadian Buffalo-berry-Hairy Wild Rye, Pine-Common Bearberry, Pine-Black Spruce-Feathermoss, Pine-Willow-Feathermoss, Pine-Bog Cranberry-Feathermoss.

Pine-Hairy Wild Rye

The Pine-Hairy Wild Rye forage type (P1) is dominated by a lodgepole pine overstory with a minor occurrence of white spruce. Common bearberry is the most prevalent shrub (Table 1, Appendix B). Prickly rose, twinflower, and green alder are also common in the shrub layer. Bunchberry, arnica and showy aster are the dominant forb species with hairy wild rye being the common grass. Both lichens and feathermoss are present with cover varying between plots.

This type occurs predominantly on saprolitic material that is well to moderately well drained. The soils are generally shallow to bedrock due to the topography of the area. The average slope is 18^{o}, on south - to southwest-facing slopes.

The Pine-Hairy Wild Rye forage type is typical of the Rocky Mountains Foothill topography and was mapped on southerly-facing slopes throughout this region.

The variation in species diversity and cover is a result of the interactions of such factors as density of stand, aspect, drainage, and elevation. For example, site 50 (Appendix B) occurs in a dense pine

TABLE 1

MAJOR SPEICES IN THE PINE-HAIRY WILD RYE FORAGE TYPE (P1) (n=14)

Species	c	%f	pi
Woody			
Common Bearberry	7.8	43	5.1
Prickly Rose	3.1	57	2.3
Twinflower	2.5	71	2.1
Green Alder	5.0	14	1.9
Herbaceous			
Bunchberry	2.6	57	2.0
Arnica	1.7	79	1.5
Showy Aster	1.6	36	1.0
Hairy Wild Rye	4.4	93	4.2
Feathermoss	14.7	79	13.1
Lichen	2.9	79	2.6

stand, on a well-drained, steep, southwest-facing slope. The understory vegetation is relatively barren with peltigera making up 26 percent of the cover. In contrast with this, site 81 (Appendix B) typifies a more productive and diverse site. The more open forest cover, moderate slope, and lower elevation of this site are responsible for its lush undergrowth.

Succession to white spruce is retarded on these slopes due to the dryness of the site and the fire history of the area.

Biomass in the type averages 284.5 kg/ha for grass and 244.4 kg/ha for forbs (Table 2). No palatable browse was observed in the B_{2a} layer and therefore no clips were done.

Pine-Labrador Tea-Feathermoss

The Pine-Labrador Tea-Feathermoss forage type (P2) is dominated by a lodgepole pine overstory. Labrador tea and bog cranberry are the two most common shrub species (Table 3, Appendix C). Bunchberry is the only dominant forb species with minor occurrences of hairy wild rye. Feathermoss has a consistently high cover throughout the type and peltigera is present but with fairly low cover values.

This forage type occurs on both morainal and saprolitic material. The type was mapped in the eastern portion of the study area, on relatively flat areas with an average slope of 6.1^{o}. It often occurs in association with wet or organic areas. The average elevation in this forage type is 1 518 m.

TABLE 2

BIOMASS DATA (kg/ha)

Community	Grass			Forbs			Palatable Browse			Total Mean
	No.	Mean	Range	No.	Mean	Range	No.	Mean	Range	
Pine-Hairy Wild Rye	5	284.5	220.0-336.0	5	244.4	126.0-348.0	0			528.8
Pine-Labrador Tea-Feathermoss	4	61.0	22.0-148.0	4	54.0	22.0-124.0	0			115.0
Pine-White Rhododenron- Feathermoss	3	3.3	0.0-8.0	3	51.3	40.0-66.0	0			54.6
Pine-Buffalo-berry-Hairy Wild Rye	8	96.5	18.0-294.0	8	67.3	10.0-174.0	4	1.4	0.0-4.7	165.2
Pine-Bearberry	4	89.5	0.0-196.0	4	46.0	0.0-102.0	0			135.5
Pine-Black Spruce-Feathermoss	7	44.9	0.0-182.0	7	59.4	24.0-156.0	0			104.3
Pine-Willow-Feathermoss	3	113.3	48.0-148.0	3	215.3	24.0-354.0	3	7.1	2.6-14.6	335.7
White Spruce-Bog Cranberry-Feathermoss	6	40.0	0.0-90.0	6	19.3	0.0-32.0	2	0.0	-	59.3
White Spruce-Feathermoss	5	118.8	4.0-294.0	5	93.6	20.0-314.0	2	0.3	0.0-0.6	212.7
White Spruce-Buffalo-berry-Hairy Wild Rye	9	167.6	76.0-250.0	9	159.1	68.0-470.0	3	1.1	0.0-1.8	327.8
White Spruce-Hairy Wild Rye	3	72.7	14.0-134.0	3	186.0	72.0-356.0	2	0.7	0.0-1.4	259.4
Engelmann Spruce-Alpine Fir-Yellow Heather	2	83.0	8.0-158.0	2	121.0	12.0-230.0	1	0	-	204.0
Black Spruce-Feathermoss	2	63.0	0.0-126.0	2	38.0	16.0-60.0	0		-	101.0
Aspen-Buffalo-berry-Hairy Wild Rye	6	312.7	212.0-444.0	6	174.0	64.0-414.0	3	5.6	0.0-16.7	492.3
Dwarf Birch-Sedge	6	461.3	196.0-1404.0	6	67.0	10.0-186.0	3	3.7	1.8-6.8	532.0
Dwarf Birch-Hair Grass	3	242.0	118.0-388.0	3	281.3	244.0-340.0	1	45.5	-	568.0
Pasture Sage-June Grass	4	417.5	254.0-504.0	4	543.5	382.0-804.0	0			961.0
Kootenay Plains Grassland	1	208.0	-	1	662.0	-	0			870.0
Bearberry-Loco-weed	4	136.0	40.0-326.0	4	179.5	150.0-230.0	0			315.5
Hair Grass Grassland	1	718.0	-	1	1056.0	-	0			1774.0
Alpine Grassland	2	284.0	10.0-558.0	2	265.0	38.0-492.0	0			549.0
Dryad Meadow	2	63.0	32.0-94.0	2	182.0	56.0-308.0	0			254.0
Clearcut	2	346.0	256.0-436.0	2	640.0	500.0-780.0	2	0	-	986.0

TABLE 3

MAJOR SPECIES IN THE PINE-LABRADOR TEA-FEATHERMOSS FORAGE TYPE (P2) (n=15)

Species	c	%f	pi
Woody			
Labrador Tea	29.5	93	28.4
Bog Cranberry	13.7	93	13.2
Twinflower	3.6	80	3.2
Alpine Fir	4.4	46	2.9
Dwarf Bilberry	2.9	60	2.2
Willow	3.3	46	2.2
Herbaceous			
Bunchberry	3.3	100	3.3
Feathermoss	88.4	100	88.4
Lichen	6.4	93	6.2

Biomass averaged 61.0 kg/ha for grass and 54.0 kg/ha for forbs. (Table 2). There was only minimal palatable browse found in the $B2_a$ layer and therefore no clips were done.

Pine-White-flowered Rhododendron-Feathermoss

The Pine-White-flowered Rhododendron-Feathermoss forage type (P3) is dominated by a lodgepole pine overstory with minor occurrences of white and Engelmann spruce. White-flowered rhododendron, bog cranberry, alpine fir and menziesia are the dominant understory shrubs (Table 4, Appendix D). One-sided wintergreen and bunchberry are the dominant forb species. Both feathermoss and lichen occur in this type with feathermoss having a consistently high cover throughout the type.

This type occurs predominantly on saprolitic material that is well to moderately well drained. The soils are generally shallow to bedrock, as a result of the surrounding topography. The average slope is 21^{o}, generally in a north to north-easterly direction. The average elevation is 1 659 metres.

This forage type is typical of the Rocky Mountain Foothills topography. White and Engelmann spruce with alpine fir regeneration are fairly common, indicating succession to these species. Ericaceous shrub cover is relatively high, due in part to the cool moist environment found here.

Biomass is low in this type with grass averaging 3.3 kg/ha and forbs averaging 51.3 kg/ha (Table 2). No palatable browse was observed

TABLE 4

MAJOR SPECIES IN THE PINE-WHITE-FLOWERED RHODODENDRON-FEATHERMOSS FORAGE TYPE (P3) (n=4)

Species	c	%f	pi
Woody			
White-flowered Rhododendron	26.3	100	26.3
Bog Cranberry	8.8	100	8.8
Alpine Fir	5.8	75	5.0
Menziesia	10.0	25	5.0
Lodgepole Pine	5.3	75	4.6
Dwarf Bilberry	4.5	75	3.9
Twinflower	3.5	100	3.5
Labrador Tea	3.8	50	2.7
Tall Bilberry	3.8	25	1.9
Engelmann Spruce	2.3	50	1.6
Herbaceous			
One-sided Wintergreen	2.8	50	2.0
Bunchberry	2.0	100	2.0
Feathermoss	66.8	100	66.8
Lichen	4.1	100	4.1

in the $B2_a$ layer and therefore no clips were done.

Pine-Canadian Buffalo-berry-Hairy Wild Rye

The Pine-Canadian Buffalo-berry Hairy Wild Rye forage type (P4) is dominated by a lodgepole pine overstory with a minor occurrence of white spruce. The dominant shrubs in the understory include Canadian buffalo-berry, twinflower, common bearberry, and prickly rose (Table 5, Appendix E). Showy aster and wild strawberry are among the dominant forb species.

This forage type occurs predominantly on morainal material along the North Saskatchewan river valley. The climate and soils in the river valley are modified due to their location. The soils are generally well developed, and the climate tends to be drier and warmer than surrounding areas, reflecting the rain shadow effect. Wind is also an important factor in community development through its effect on evapotranspiration and on storm patterns. The occurrence of such species as common bearberry and ground juniper are indicative of a dry environment.

The slopes are low, averaging 3^{o} and the average elevation is 1 369 m.

Biomass in this type averages 96.5 kg/ha for grass and 67.3 kg/ha for forbs (Table 2). Shrub species are abundant in this type; however, browse biomass is low, averaging 1.4 kg/ha. This is due to the absence of palatable shrub species.

TABLE 5

MAJOR SPECIES IN THE PINE-CANADIAN BUFFALO-BERRY-HAIRY WILD RYE FORAGE TYPE (P4) (n=8)

Species	c	%f	pi
Woody			
Canadian Buffalo-berry	36.9	100	36.9
Twinflower	11.3	100	11.3
Common Bearberry	10.0	100	10.0
Prickly Rose	5.1	88	4.8
White Meadowsweet	2.8	38	1.7
Ground Juniper	1.9	38	1.2
Herbaceous			
Showy Aster	3.4	63	2.7
Wild Strawberry	1.8	100	1.8
Hairy Wild Rye	3.6	100	3.6
Feathermoss	29.3	100	29.3
Lichen	1.8	100	1.8

Pine-Common Bearberry

The Pine-Common Bearberry forage type (P5) is largely covered with a lodgepole pine overstory with limber pine occurring in the odd case. The understory, although sparse, is dominated by shrub species, including common bearberry, Canadian buffalo-berry, prickly rose, and shrubby cinquefoil (Table 6, Appendix F). Various forb and grass species are present; however, only hairy wild rye appears as a dominant in the appendix.

This forage type occurs on exposed, wind-blown ridges within the North Saskatchewan river valley. Dispersed within this type are openings in the forest canopy. Dry grasslands and rock outcrops commonly occur in these openings.

Slopes are generally low, averaging 5^{o}, and the average elevation is 1 478 m.

Grass species constitute the largest portion of the total biomass, averaging 89.5 kg/ha, while forbs average only 46.0 kg/ha (Table 2). No palatable shrubs were observed in the $B2_a$ layer and therefore no browse clips were done.

Pine-Black Spruce-Feathermoss

The Pine-Black Spruce-Feathermoss forage type (P6) is dominated by a lodgepole pine overstory with major occurrences of black spruce. Labrador tea, bog cranberry, black spruce and twinflower are common

TABLE 6

MAJOR SPECIES IN THE PINE-COMMON BEARBERRY FORAGE TYPE (P5) (n=4)

Species	c	%f	pi
Woody			
Common Bearberry	30.0	75	26.0
Canadian Buffalo-berry	5.0	50	3.5
Prickly Rose	5.0	50	3.5
Shrubby Cinquefoil	4.5	50	3.2

species in the understory (Table 7, Appendix G). The only significant forb is bunchberry,with hairy wild rye dominating the grass layer. Feathermoss has a consistently high cover value throughout the type. Lichens are present but with low cover values.

This type occurs predominantly on saprolitic material in poorly-drained or seepage areas. The topography is generally flat with an average slope of 4^{o}. This forage type was mapped in the eastern portion of the study area where the average elevation of this forage type is 1 477 m.

The successional trend may be towards black spruce since there is significant regeneration of this species in the understory.

Biomass in this type averages 44.9 kg/ha for grass and 59.4 kg/ha for forbs (Table 2). No palatable browse in the $B2_a$ layer was observed and therefore no clips were done.

Pine-Willow-Feathermoss

The Pine-Willow-Feathermoss forage type (P7) is dominated by a lodgepole pine overstory with a minor occurrence of white spruce. Common shrubs in the understory include willow, lodgepole pine, twinflower, and bog cranberry (Table 8, Appendix H). Tall mertensia, bunchberry, dwarf raspberry, and arnica are among the dominant forb species.

This forage type occurs predominantly on saprolitic material in

TABLE 7

MAJOR SPECIES IN THE PINE-BLACK SPRUCE-FEATHERMOSS FORAGE TYPE (P6) (n=7)

Species	c	%f	pi
Woody			
Labrador Tea	11.1	67	9.1
Bog Cranberry	9.1	86	8.4
Black Spruce	5.4	86	5.0
Twinflower	4.7	71	4.0
Dwarf Bilberry	1.9	29	1.0
Herbaceous			
Bunchberry	4.6	100	4.6
Hairy Wild Rye	2.3	71	1.9
Feathermoss	89.6	100	89.6
Lichen	8.6	86	8.0

TABLE 8

MAJOR SPECIES IN THE PINE-WILLOW-FEATHERMOSS FORAGE TYPE (P7) (n=4)

Species	c	%f	pi
Woody			
Willow	23.5	75	20.4
Lodgepole pine	7.5	75	6.5
Twinflower	6.5	75	5.6
Bog Cranberry	4.0	100	4.0
Labrador Tea	6.3	25	3.2
Dwarf Bilberry	2.8	100	2.8
Canadian Buffalo-berry	5.0	25	2.5
Herbaceous			
Tall Mertensia	1.9	100	1.9
Bunchberry	1.9	100	1.9
Dwarf Raspberry	1.8	50	1.3
Arnica	1.5	100	1.5
Fireweed	1.1	100	1.1
Palmate-leaved Coltsfoot	1.1	75	1.0
Hairy Wild Rye	2.1	100	2.1
Pine Grass	2.0	75	1.7
Feathermoss	61.5	100	61.5
Sphagnum	4.0	25	2.0
Lichen	3.0	100	3.0

seepage areas associated with small fluvial systems. These areas occur sporadically throughout the Rocky Mountain Foothills Region but were too small to be mapped at the 1:50 000 scale. Since willow, a palatable browse species, is a common shrub in this type, it is expected that these areas would be important for wildlife.

Slopes average 7.5^{o} and the average elevation is 1 550 m.

Biomass is relatively high with grass averaging 113.3 kg/ha, forbs averaging 215.3 kg/ha and palatable browse averaging 7.1 kg/ha (Table 2).

Pine-Bog Cranberry-Feathermoss

The Pine-Bog Cranberry-Feathermoss forage type (P8) is dominated by lodgepole pine with white spruce occurring frequently. The shrub layer is dominated by bog cranberry, Labrador tea, and willow (Table 9, Appendix 1). The forb layer is almost non-existent and a high cover of feathermoss is common.

This type occurs predominantly in the southeastern portion of the study area on cool northerly slopes. The parent materials are saprolite or morainal with relatively shallow depths to bedrock. Slopes average 23^{o} and elevation ranges from 1 490 to 1 715 m.

The species present in this forage type represent a moist environment which is associated with cool northerly slopes. These slopes receive low radiation compared with the south slopes and therefore, the

TABLE 9

MAJOR SPECIES IN THE LODGEPOLE PINE-BOG CRANBERRY-FEATHERMOSS FORAGE TYPE

Species	c	%f	pi
Woody			
Bog cranberry	18.3	100	18.3
Labrador tea	7.0	100	7.0
Twinflower	5.0	100	5.0
White spruce	3.3	83	3.0
Buffalo-berry	2.0	33	1.1
Willow	1.7	33	1.0
Herbaceous			
Feathermoss	74.2	100	74.2
Peltigera spp.	1.8	67	1.5

NOTE: Data taken from Ram Clearwater Study 1982

available moisture is higher. This cool moist microclimate restricts the number of plant species that can occur. Due to these environmental conditions a spruce community is likely to succeed this forage type.

This forage type was not sampled in the Chungo-Cline-Nordegg Study Area. Plot data was taken from the Ram-Clearwater Study (1982).

Pine Discussion

Pine dominates a large portion of the Chungo-Cline-Nordegg Study Area. Extensive disturbance by fire has allowed lodgepole pine to establish and succeed in much of the area.

The lodgepole pine forage types already discussed can be separated according to their location; the portion of the study area east of the first main range typically has a lower relief and the portion west of the first main range is of higher relief and contains more mountainous vegetation communities.

The Pine-Labrador Tea-Feathermoss and the Pine-Black Spruce-Feathermoss forage types most commonly occur in the eastern portion. These two types have similar understory vegetation with feathermoss covering a large portion of the forest floor in both cases.

The Pine-Labrador Tea-Feathermoss forage type occurs predominantly on morainal parent material. The Pine-Black Spruce-Feathermoss forage type occurs most often on saprolitic material, is generally wetter than

the former type and occurs in association with wetland areas.

The remaining lodgepole pine forage types occur west of the first main range. Two areas can be discussed: the mountainous region and the North Saskatchewan river valley.

Aspect plays a major role in community development in the mountainous regions. South-facing slopes are much warmer and drier due to the high evaporation rate and insolating effects of the sun. Pine-Hairy Wild Rye is the predominant forage type on southeast to west-facing slopes. The Pine-Hairy Wild Rye type has a higher species diversity and productivity than the Pine-White-flowered Rhododendron-Feathermoss type which commonly occurs on the more northerly-facing slopes. This latter type has a lower productivity with an increase in the cover of ericaceous shrubs and feathermoss. In the southern part of the study area, the northerly-facing slopes are predominantly Pine-Bog Cranberry-Feathermoss. This forage type is comparable to the Pine-White-flowered Rhododendron-Feathermoss type, except for a decrease in the cover of White-flowered Rhododendron and menziesia and an increase in the cover of vaccinium species.

Occurring between the ridges are seepage areas where Pine-Willow-Feathermoss commonly occurs.

The North Saskatchewan river valley is modified by winds and rain shadow effects. Dessicating effects of wind and low precipitation are responsible for the relatively dry communities found in the valley. The Pine-Canadian Buffalo-berry forage type dominates the river valley on

morainal material. Species such as bearberry and juniper indicate the dry microsites where this type occurs. The Pine-Common Bearberry forage type occurs in more exposed areas an on coarser materials than the above type. The increased dessication through exposure to wind and sun is responsible for the decrease in productivity and species diversity.

4.2 Spruce Forage Types

White and Engelmann spruce typically occur in moist microclimates such as on cool north-facing slopes and at high elevations. Limited disturbance by fire in these moist areas has allowed for succession to mature spruce stands.

Six spruce dominated forage types occur in the study area: White Spruce-Bog Cranberry-Feathermoss, White Spruce-Feathermoss, White Spruce-Canadian Buffalo-berry-Hairy Wild Rye, White Spruce-Hairy Wild Rye, Engelmann Spruce-Alpine Fir-Yellow Heather, Black Spruce-Feathermoss.

White Spruce-Bog Cranberry-Feathermoss

The White Spruce-Bog Cranberry-Feathermoss forage type (Swl) is dominated by white x Engelmann spruce with lodgepole pine and alpine fir occurring to a lesser extent. Bog cranberry, white x Engelmann spruce, alpine fir, and willow are all common species in the shrub layer (Table 10, Appendix J). Forb cover is generally low with arnica and bunchberry dominating the forb layer. Hairy wild rye has the highest cover in the grass layer. Feathermoss is the most dominant of all species with a

TABLE 10

MAJOR SPECIES IN THE WHITE SPRUCE-BOG CRANBERRY-FEATHERMOSS FORAGE TYPE (Sw1) (n=9)

Species	c	%f	pi
Woody			
Bog Cranberry	7.2	44	4.8
White Spruce X Engelmann Spruce	4.9	78	4.3
Alpine Fir	5.3	56	4.0
Willow Spp.	4.0	44	2.7
Labrador Tea	2.4	33	1.4
Twinflower	1.7	44	1.1
Herbaceous			
Arnica	2.8	78	2.5
Bunchberry	1.7	44	1.1
Hairy Wild Rye	2.9	67	2.4
Feathermoss	82.0	100	82.0
Lichen	8.4	100	8.4

prominence index of 82.0 and peltigera is also quite common.

This forage type occurs mainly on saprolitic material with shallow depths to bedrock.

This type represents a more advanced successional stage, due in part to infrequent forest fires. White Spruce-Bog Cranberry-Feathermoss is found and was mapped on north-facing slopes, commonly above 1 500 m. The location of this forage type indicates a cool moist microclimate. Due to this harsh environment and the maturity of the stand, there is low species diversity and cover in the understory and a high cover of feathermoss.

Slopes average 19.2^{o} and the average elevation is 1 733 m.

As expected, biomass figures are low, with an average of 40.0 kg/ha for grass, 19.3 kg/ha for forbs and 0.0 kg/ha for palatable browse (Table 2).

White Spruce-Feathermoss

The White Spruce-Feathermoss forage type (Sw2) is dominated by a white spruce overstory with minor occurrences of lodgepole pine. Both twinflower and Labrador tea are common species in the shrub layer (Table 11, Appendix K). Bunchberry is the dominant forb with minor occurrences of tall mertensia, arnica, wild strawberry, and palmate-leaved coltsfoot. Hairy wild rye has a relatively high cover in the grass layer. Feathermoss is

TABLE 11

MAJOR SPECIES IN THE WHITE SPRUCE-FEATHERMOSS FORAGE TYPE (Sw2) (n=6)

Species	c	%f	pi
Woody			
Twinflower	9.5	83	8.7
Labrador Tea	7.0	33	4.0
Currant	2.0	33	1.1
Willow	2.0	33	1.1
Prickly Rose	1.8	33	1.0
Bog Cranberry	1.2	67	1.0
Herbaceous			
Bunchberry	1.9	83	1.7
Hairy Wild Rye	1.3	100	1.3
Feathermoss	78.3	100	78.3
Lichen	3.5	83	3.2

a very common ground species and peltigera is present but with low cover.

This forage type occurs in moist areas within the fluvial system. Slopes are generally low, averaging 5^{o} and the average elevation is 1 354 m.

Biomass is quite high with grass averaging 118.8 kg/ha, forbs averaging 93.6 kg/ha and palatable browse averaging 0.3 kg/ha (Table 2).

White Spruce-Canadian Buffalo-berry Hairy Wild Rye

The White Spruce-Canadian Buffalo-berry-Hairy Wild Rye forage type (Sw3) is dominated by a white spruce overstory with minor occurrences of trembling aspen, lodgepole pine, and balsam poplar. Canadian buffalo-berry, common bearberry, prickly rose and white spruce are all dominant shrubs in the understory (Table 12, Appendix L). Common forbs include wild strawberry, showy aster, and peavine with hairy wild rye occurring in the grass layer.

This forage type occurs on both morainal and saprolitic material along the North Saskatchewan river. Areas in which this type occurs are relatively dry, as indicated by the abundance of such species as Canadian buffalo-berry, prickly rose, and common bearberry.

Slopes are gentle, averaging 3^{o}, and the average elevation is 1 368 m.

Biomass is relatively high in this type, with grass averaging 167.6 kg/ha, forbs averaging 159.1 kg/ha and palatable browse averaging 1.1 kg/ha (Table 2).

TABLE 12

MAJOR SPECIES IN THE WHITE SPRUCE-CANADIAN BUFFALO-BERRY-HAIRY WILD RYE FORAGE TYPE (Sw3) (n=13)

Species	c	%f	pi
Woody			
Canadian Buffalo-berry	29.6	100	29.6
Common Bearberry	12.1	62	9.5
Prickly Rose	7.0	85	6.5
White Spruce	7.3	46	5.0
Twinflower	2.8	62	2.2
Ground Juniper	2.3	31	1.3
Willow	2.2	31	1.2
Herbaceous			
Wild Strawberry	2.7	85	2.5
Showy Aster	2.8	54	2.1
Pea Vine	1.3	54	1.0
Hairy Wild Rye	5.1	100	5.1
Sedge	1.2	69	1.0
Feathermoss	34.5	92	33.1
Lichen	1.4	62	1.1

White Spruce-Hairy Wild Rye

The White Spruce-Hairy Wild Rye forage type (Sw4) is dominated by a white spruce overstory with a minor occurrence of lodgepole pine and alpine fir. The dominant shrub species include twinflower, prickly rose, Canadian buffalo-berry, and alpine fir (Table 13, Appendix M). Bunchberry, bishop's-cap, and palmate-leaved coltsfoot are among the dominants in the forb layer with hairy wild rye having a relatively high cover value in the grass layer.

This forage type occurs predominantly on morainal material. This forage type is limited in extent and is found only in the eastern portion of the study area on south-facing slopes.

The average slope for this forage type is 12^{o} and the average elevation is 1 532 m.

Biomass averages 72.7 kg/ha for grass, 186.0 kg/ha for forbs and 0.7 kg/ha for palatable browse (Table 2).

Engelmann Spruce-Alpine Fir-Yellow Heather

The Engelmann Spruce-Alpine Fir-Yellow Heather forage type (Sel) is dominated by an Engelmann spruce overstory with a high incidence of alpine fir. Common species in the shrub layer include yellow heather, alpine fir, willow and white heather (Table 14, Appendix N). Lindley's aster, lousewort, and groundsel are the dominant forbs with hairy wild rye occurring in the grass layer.

TABLE 13

MAJOR SPECIES IN THE WHITE SPRUCE-HAIRY WILD RYE FORAGE TYPE (Sw4) (n=3)

Species	c	%f	pi
Woody			
Twinflower	8.3	100	8.3
Prickly Rose	7.9	100	7.9
Canadian Buffalo-berry	5.0	67	4.1
Alpine Fir	3.5	100	3.5
White Spruce	1.7	67	1.4
Currant	1.7	33	1.0
Herbaceous			
Bunchberry	4.3	100	4.3
Bishop's-cap	1.5	100	1.5
Palmate-leaved Coltsfoot	1.5	100	1.5
Hairy Wild Rye	2.3	100	2.3
Feathermoss	70.0	100	70.0
Lichen	1.5	100	1.5

TABLE 14

MAJOR SPECIES IN THE ENGELMANN SPRUCE-ALPINE FIR FORAGE TYPE (Sel) (n=3)

Species	c	%f	pi
Woody			
Yellow Heather	71.7	100	71.7
Alpine Fir	8.0	100	8.0
Willow	6.7	100	6.7
White Heather	5.3	67	4.3
Herbaceous			
Lindley's Aster	3.3	67	2.7
Lousewort	2.8	67	2.3
Groundsel	2.2	100	2.2
Hairy Wild Rye	2.8	67	2.3
Feathermoss	40.7	67	33.3
Lichen	11.7	100	11.7

This type generally occurs on very shallow soils over bedrock just below treeline. Due to the harsh environment in which this type occurs, the understory tends to be quite sparse with the exception of ericaceous heathers.

Slopes are steep, averaging 17.6° and the average elevation is 2 043 m.

Biomass is greater than would be expected in a mature forest at such high elevations. The productivity averaged 83.0 kg/ha for grass, 121.0 kg/ha for forbs, and 0.0 kg/ha for palatable browse (Table 2).

Black Spruce-Feathermoss

The Black Spruce-Feathermoss forage type (Sbl) is dominated by a black spruce overstory with a minor occurrence of lodgepole pine. Willow, Labrador tea, black spruce, bog cranberry, and dwarf birch are among the dominant shrub species (Table 15, Appendix 0). Equisetum is the only common forb with sedges and rushes dominating the grass layer. Feathermoss has a consistently high cover throughout the type, with sphagnum moss occurring in the wetter sites.

This type occurs predominantly on morainal material in poorly-drained areas. The understory vegetation reflects the moist site conditions.

The sample sites are generally flat, with an average slope of 2.7°, and the average elevation is 1 475 m.

TABLE 15

MAJOR SPECIES IN THE BLACK SPRUCE-FEATHERMOSS FORAGE TYPE (Sb1) (n=6)

Species	c	%f	pi
Woody			
Willow	14.0	100	14.0
Labrador Tea	12.5	67	10.2
Black Spruce	8.0	67	6.5
Bog Cranberry	7.5	67	6.1
Dwarf Birch	4.0	50	2.0
Herbaceous			
Sedge	3.2	67	2.6
Rush	2.1	67	1.7
Feathermoss	68.5	100	68.5
Sphagnum	11.7	50	8.3
Lichen	2.5	83	2.3

Biomass is generally low, with grass averaging 63.0 kg/ha and forbs averaging 38.0 kg/ha (Table 2). There was no palatable browse found in the $B2_a$ layer and therefore no clips were done.

Spruce Discussion

The spruce forage types are influenced to a large degree by the climatic influences of aspect and elevation.

The cool, moist north-facing slopes above 1 500 metres are dominated by the White Spruce-Bog Cranberry-Feathermoss forage type. On the warmer, more exposed south-facing slopes, White Spruce-Hairy Wild Rye type predominates. This latter forage type has a higher cover of forbs and grass and fewer ericaceous shrubs than the White Spruce-Bog Cranberry-Feathermoss type.

The Engelmann Spruce-Alpine Fir-Yellow Heather forage type occurs at elevations above both of the preceding types. Harsh climate and poor soil development restrict the growth of herbaceous species; consequently, productivity is low.

The White Spruce-Feathermoss forage type occurs in the narrow fluvial systems throughout the study area. The understory is highly variable and depends partly on the coarseness of materials and on soil moisture.

The Black Spruce-Feathermoss type is restricted to low-lying areas usually in association with bogs or brushlands. This is the most poorly drained spruce type as indicated by the black spruce overstory. Species

diversity and productivity are low in these wet and nutrient-poor areas.

The White Spruce-Canadian Buffalo-berry forage type is unique to the drier North Saskatchewan river valley. It is floristically similar to the Pine-Canadian Buffalo-berry forage type which it grows in association with.

4.3 Aspen Forage Type

Only one aspen community exists in the study area. It is unique to the North Saskatchewan river valley and the Kootenay Plains.

Aspen-Prickly Rose-Hairy Wild Rye

The Aspen-Prickly Rose-Hairy Wild Rye forage type (A1) is dominated by an aspen overstory with a minor occurrence of white spruce. The dominant shrub species include Canadian buffalo-berry, prickly rose, common bearberry, white spruce and aspen (Table 16, Appendix P). Wild strawberry, pea vine, palmate-leaved coltsfoot, Lindley's aster and hairy wild rye are all common species in the forb and grass layers respectively.

This forage type occurs predominantly on fluvial fans within the North Saskatchewan river valley. Climatic conditions, such as exposure to high temperature and winds, are at least in part responsible for the occurrence of aspen in this area.

The average slope of the sites sampled is 2.5^{o} with an average elevation of 1 400 m. The areas are well drained, as indicated by such species as common bearberry and Canadian buffalo-berry.

TABLE 16

MAJOR SPECIES IN THE ASPEN-CANADIAN BUFFALO-BERRY-HAIRY WILD RYE FORAGE TYPE (A1) (n=6)

Species	c	%f	pi
Woody			
Canadian Buffalo-berry	14.2	83	12.9
Prickly Rose	7.5	100	7.5
Common Bearberry	5.3	50	3.7
White Spruce	4.3	67	3.5
Aspen	2.7	50	1.9
Herbaceous			
Wild Strawberry	2.6	83	2.4
Pea Vine	2.3	83	2.1
Palmate-leaved Coltsfoot	4.2	17	1.7
Lindley's Aster	1.9	50	1.3
Hairy Wild Rye	4.5	100	4.5

Biomass is relatively high with grass averaging 312.7 kg/ha, forbs averaging 174.0 kg/ha and palatable browse averaging 5.6 kg/ha (Table 2).

Aspen Discussion

The Aspen-Prickly Rose-Hairy Wild Rye forage type is dominated by both prickly rose and Canadian buffalo-berry. It is floristically similar to the previously mentioned Canadian buffalo-berry types, except it has a more diverse understory and a somewhat higher biomass.

4.4 Brushlands

The three brushland types identified in the study area occur in association with major fluvial systems. Two of the types are high in both species diversity and productivity. The third brushland type occurs in the disturbed portion of the fluvial system and is highly variable in terms of species cover and productivity.

Dwarf Birch-Sedge

The Dwarf Birch-Sedge forage type (B1) is generally dominated by a dwarf birch cover although in some cases willow may actually be the dominant shrub (Table 17, Appendix Q). Dwarf raspberry, indicative of very wet sites, is the only common forb species. Grass and grass-like species, including sedge, rush, and marsh reed grass, have a very high cover in this type. Both feathermoss and sphagnum are common in the moss layer.

TABLE 17

MAJOR SPECIES IN THE DWARF BIRCH-SEDGE FORAGE TYPE (B1) (n=10)

Species	c	%f	pi
Woody			
Dwarf Birch	34.3	90	32.5
Willow	32.2	100	32.2
Black Spruce	3.9	50	2.7
Herbaceous			
Sedge	11.0	100	11.0
Rush	1.9	60	1.5
Feathermoss	29.9	100	29.9
Sphagnum	24.6	70	20.6

Small areas of pure sedge occur as inclusions in the Dwarf Birch-Sedge type. These areas of pure sedge are highly variable and were not sampled or mapped as an individual forage type.

The Dwarf Birch-Sedge forage type occurs predominantly in poorly-drained fluvial systems. The average slope is 0.4^{o} and the average elevation is 1 434 m.

Biomass is relatively high with grass averaging 461.3 kg/ha, forbs averaging 67.0 kg/ha and palatable browse averaging 3.7 kg/ha (Table 2). The biomass for browse species is less than would be expected. This is due to the slow growth on individual twigs and the fact that a large amount of the dwarf birch actually occurred below the expected snow depth level and therefore was not sampled.

Dwarf Birch-Hair Grass

The Dwarf Birch-Hair Grass forage type (B2) is dominated by a shrub cover of both dwarf birch and willow with a high incidence of shrubby cinquefoil (Table 18, Appendix R). Lindley's aster, common yarrow, veiny meadow rue, and tall larkspur are among the most common forb species. A variety of grass and grass-like species are present including hairy wild rye, sedge, rush, hair grass, and brome.

The Dwarf Birch-Hair Grass type occurs in association with fluvial areas where drainage may range from poorly - to moderately well-drained. The topography is generally flat and the average elevation is 1 639 m.

TABLE 18

MAJOR SPECIES IN THE DWARF BIRCH_HAIR GRASS FORAGE TYPE (B2) (n=4)

Species	c	%f	pi
Woody			
Willow	32.0	100	32.0
Dwarf Birch	32.0	75	19.0
Shrubby Cinquefoil	2.5	50	1.8
Herbaceous			
Lindley's Aster	4.0	75	3.5
Common Yarrow	2.9	100	2.9
Veiny Meadow Rue	2.8	100	2.8
Tall larkspur	2.0	100	2.0
Geranium	2.8	25	1.4
Northern Bedstraw	1.4	100	1.4
Cinquefoil	1.4	100	1.4
Wild Strawberry	1.5	75	1.3
Purple Avens	2.0	25	1.0
Hairy Wild Rye	3.0	100	3.0
Sedge	2.5	75	2.2
Rush	2.3	75	2.0
Tufted Hair Grass	1.6	75	1.4
Feathermoss	3.5	75	3.0

Biomass is relatively high, with grass averaging 242.0 kg/ha, forbs averaging 281.3 kg/ha and palatable browse averaging 45.5 kg/ha (Table 2).

Occurring as inclusions within the Dwarf Birch-Hair Grass forage type are areas of pure hair grass. These areas do not occur extensively and are too small to be mapped. They were sampled, however, as they are areas of high biomass.

The dominant species include tall mertensia, veiny meadow rue, common yarrow, cinquefoil, tall larkspur, northern bedstraw and others (Appendix S). Common grasses include hair grass, hairy wild rye, and wheat grasses.

The Hair Grass forage type has the highest biomass of all the types with an average of 718.0 kg/ha for grasses and 1 056.0 kg/ha for forbs (Table 2).

Fluvial Brushland

The fluvial brushland forage type (B3) occurs on the disturbed portion of the North Saskatchewan fluvial system. This type is representative of an early successional stage caused by recurring floods. The B3 forage type was not sampled in the usual manner due to its extreme diversity. Specific plot data, therefore, is not available.

This disturbed portion of the fluvial system is a combination of barren sand bars and sparsely vegetated areas on coarse-textured materials. The dominant species include silver-berry, willow, bearberry, hedysarum,

strawberry, common yarrow, and hairy wild rye.

Species composition and productivity differ between sites due to the variability associated with this type. Drainage conditions, soil materials, etc., can change dramatically within a short distance, resulting in diverse vegetation patterns.

Brushland Discussion

Of the three brushland types described, the Dwarf Birch-Sedge is the most dominant. It occurs in major fluvial systems throughout the study area. Commonly, a gradient exists within this type, from very wet to relatively dry, with dispersed areas of pure sedge.

The Dwarf Birch-Hair Grass type occurs at the drier end of the gradient. It is less common than the above type, produces more biomass and has some dispersed grassy areas. Species adapted to somewhat drier sites, such as hairy wild rye and hair grass, dominate these grassy areas.

The fluvial brushland type occurs as a result of recurring floods on the North Saskatchewan fluvial system. This area was not sampled in the usual manner due to the diversity in vegetation patterns found there.

4.5 Grassland Forage Types

Grassland forage types in the study area reflect conditions where climatic, edaphic or disturbance factors have precluded establishment of a major tree overstory. These areas are variable, in terms of both their

location and species diversity.

Pasture Sage-June Grass

The Pasture Sage-June Grass forage type (G1) is devoid of a tree overstory. It occurs predominantly on saprolitic material with shallow depths to bedrock. This forage type occurs sporadically on the steep, south-facing slopes of the North Saskatchewan river valley.

Dominant shrub species include pasture sage, prickly rose, snowberry and shrubby cinquefoil (Table 19, Appendix T). Common forbs include late yellow loco-weed, northern bedstraw, pussy-toes, and wild strawberry with fescue and June grass being most common in the grass layer.

Slopes are generally steep, averaging 24.5^{o}, and the average elevation is 1 545 m.

Biomass is relatively high, with an average of 417.5 kg/ha for grass and 543.5 kg/ha for forbs (Table 2). No palatable browse was observed in the $B2_a$ layer and therefore no clips were done.

Kootenay Plains Grassland

The Kootenay Plains Grassland (G2) occurs on the Kootenay Plains in the southwestern portion of the study area. Coarse materials and rain shadow effects result in a very dry microsite. This unique grassland forage type is typical of the Montane Ecoregion.

TABLE 19

MAJOR SPECIES IN THE PASTURE SAGE-JUNE GRASS FORAGE TYPE (G1) (n=4)

Species	c	%f	pi
Woody			
Pasture Sage	23.3	100	23.3
Prickly Rose	7.5	50	5.3
Snowberry	3.3	50	2.3
Shrubby Cinquefoil	2.8	50	2.0
Herbaceous			
Late Yellow Loco-weed	9.6	100	9.6
Northern Bedstraw	2.5	75	2.2
Pussy-toes	2.9	50	2.1
Wild Strawberry	2.0	75	1.7
Bastard Toad-flax	1.4	100	1.4
Milk Vetch	2.0	50	1.4
Bluebell	1.3	75	1.1
Felwort	1.1	75	1.0
Fescue	2.6	75	2.3
June Grass	2.5	75	2.2
Sedge	1.8	75	1.6
Northern Wheatgrass	1.4	100	1.4

TABLE 20

MAJOR SPECIES IN THE KOOTENAY PLAINS GRASSLAND FORAGE TYPE (G2) (n=2)

Species	c	%f	pi
Herbaceous			
Pussy-toes	16.0	100	16.0
Milk Vetch	11.0	100	11.0
Northern Wheatgrass	1.5	100	1.5
Purple Reed Grass	2.0	50	1.4

The dominant forb species include pussy-toes, milk vetch and graceful cinquefoil (Table 20, Appendix U). Northern wheat grass, purple reed grass and June grass are among the common grass species.

This grassland generally occurs on fluvial terraces of the North Saskatchewan River at an average elevation of 1 410 m. The area is quite arid and well drained.

Biomass is relatively high, with an average of 208.0 kg/ha for grass and 662.0 kg/ha for forbs (Table 2). No palatable browse was observed in the $B2_a$ layer and therefore no clips were done.

Common Bearberry-Late Yellow Loco-weed

The Common Bearberry-Late Yellow Loco-weed forage type (G3) occurs sporadically on the south-facing slopes of the North Saskatchewan river valley. Fire has removed the overstory vegetation. The establishment of a forest overstory will be slow due to the aridity of these areas, although white spruce appears to be regenerating.

In addition to white spruce, common bearberry, creeping juniper, shrubby cinquefoil, and prickly rose are also common shrub species (Table 21, Appendix V). Dominant forbs include hedysarum, wild strawberry, and late yellow loco-weed.

Slopes are generally steep, averaging 18^{o}, and the average elevation is 1 300 m.

TABLE 21

MAJOR SPECIES IN THE COMMON BEARBERRY-LATE YELLOW LOCO-WEED FORAGE TYPE (G3) (n=4)

Species	c	%f	pi
Woody			
Common Bearberry	41.3	100	41.3
Shrubby Cinquefoil	9.8	75	8.5
Canadian Buffalo-berry	8.3	100	8.3
Creeping Juniper	7.3	100	7.3
Prickly Rose	6.3	75	5.5
Ground Juniper	5.3	100	5.3
White Spruce	2.0	50	1.4
Herbaceous			
Hedysarum	3.0	100	3.0
Wild Strawberry	2.6	100	2.6
Late Yellow Loco-weed	2.1	100	2.1
Northern Bedstraw	1.5	100	1.5
Pussy-toes	1.3	75	1.1

The biomass is quite low for a grassland, due in part to the high cover of unpalatable shrubs. The average biomass for grass is 136.0 kg/ha and 179.5 kg/ha for forbs (Table 2). No browse clips were done.

Grassland Discussion

Three grassland forage types have been identified and mapped in the study area. Species diversity in each type reflect varying degrees of aridity. Exposure, resulting in high moisture deficits is responsible for the development of grasslands as opposed to forested communities.

Productivity is variable, with the Pasture Sage-June Grass forage type producing the highest biomass and the Bearberry-Loco-weed type the lowest.

4.6 Alpine Forage Type

Alpine communities occur above the tree-line, which is normally above 2 000 m in this part of the province. The community types are highly variable in terms of disturbance and species diversity. This variability is dependent on such factors as exposure, soil depth, moisture availability, and snow cover.

Of the areas sampled, the community types found can be grouped into two main categories: those dominated by white dryad (Appendix W, Plot #117) and those dominated by kobresia (Appendix W, Plot #110).

The kobresia grassland generally occurs on steep south to south-

west-facing slopes where soil profiles are relatively well developed. This community has less shrub development and higher productivity than the white dryad meadow. Dominant species in the kobresia grassland include kobresia, hairy wild rye, willow, white dryad, bluegrass, bistort, fireweed, white camas, hedysarum and arnica (Appendix W).

In contrast, the white dryad meadow generally occurs on the more exposed ridges where soil development is minimal. Shrub species including white dryad and willow are very dominant in this community (Appendix W). Other common species include goldenrod, bistort, Engelmann spruce, felwort, white camas and ragwort.

There are a number of other community types found in the alpine area, such as: heather-dominated communities, indicating areas where snow melt is very late, and willow-dominated communities, which indicate seepage zones. These two communities were not sampled in this survey.

The variation in the sites sampled and the limited number of plots established in the alpine area do not permit averaging of data.

Data for individual plots, however, is given in Appendix W.

4.7 Other Forage Types

Clearcut

The Clearcut forage type (D1) represents an early successional stage. This type is extremely variable, depending on the time and loca-

tion of forest harvesting. Sample sites occurred on both morainal and saprolitic parent material.

The dominant shrub species include prickly rose, twinflower, and wild red raspberry (Table 22, Appendix X). Fireweed, palmate-leaved coltsfoot, tall mertensia and smooth aster are among the most common forb species.

Biomass is fairly consistent, with an average of 346.0 kg/ha for grass, 640.0 kg/ha for forbs, and 0.0 kg/ha for palatable browse (Table 2).

Exposed Bedrock

Areas of exposed rock (E) occur at high elevations in the mountains. These areas are generally barren of vegetation.

TABLE 22

MAJOR SPECIES IN THE CLEARCUT FORAGE TYPE (D1) (n=2)

Species	c	%f	pi
Woody			
Prickly Rose	1.5	50	1.1
Twinflower	1.0	100	1.0
Herbaceous			
Fireweed	7.0	100	7.0
Palmate-leaved Coltsfoot	3.5	100	3.5
Tall Mertensia	3.0	50	2.1
Smooth Aster	2.5	50	1.8
Common Dandelion	1.3	100	1.3
Hairy Wild Rye	2.5	100	2.5
Sedge	1.8	100	1.8
Purple Reed Grass	2.5	50	1.8
Hair Grass	1.5	50	1.1
Feathermoss	13.5	100	13.5

5. SUMMARY AND CONCLUSIONS

The Chungo-Cline-Nordegg Study Area includes a number of complex vegetation types. The variation among and within these vegetation types is due to a combination of geomorphic and biological factors. Twenty-four forage types were identified in the area. Of these, eight are pine-dominated, six are spruce-dominated, one is aspen-dominated, three occur in brushland areas, four are grasslands (including the Alpine forage type), and two are described as "other", which includes clearcuts and areas of exposed bedrock.

Lodgepole pine forage types are the most extensive, largely due to fire disturbance. Generally, pine forests represent an early successional stage however, in some cases they are considered climatic or edaphic climaxes. Aspen is one of the most important factors affecting community composition in lodgepole pine types, although parent materials and drainage are important in localized areas.

The more mature spruce stands generally occur on cooler, more moist, north-facing slopes at higher elevations than the pine types. They represent advanced successional stages and, as such, have been protected from fire for relatively long periods of time. Species diversity and productivity are low, with the forb layer being largely replaced by moss species.

Only one aspen forage type is present in the study area. This type is unique to the North Saskatchewan river valley and the Kootenay

Plains. Productivity and species diversity are both relatively high.

Brushland areas commonly occur on major fluvial systems throughout the study area. They occur mainly as a complex of vegetation represented by areas of shrub with dispersed grasslands. The moisture status of each site is responsible for the particular vegetation present.

The grassland forage types occur predominantly on flats or south-facing slopes within the North Saskatchewan river valley. The alpine forage type consists of a number of vegetation communities, of which two were sampled and described.

Clearcuts and areas of exposed rock are placed under the heading other forage types. Clearcut areas are not extensive in the study area. Exposed rock covers large areas at high elevations in the mountains, and is generally barren of vegetation.

APPENDICES

APPENDIX A

FOOTNOTES TO APPENDICES B-X

Species Composition

Abbreviations:

c	=	percent cover
f	=	percent frequency
pi	=	prominence index = $c \times \sqrt{f \div 100}$
A1	=	overstory tree species
A2	=	understory tree species greater than 5 metres tall
B1	=	shrub species 2.5-5.0 metres
$B2_a$	=	shrub species 0.5-2.5 metres
$B2_b$	=	shrub species less than 0.5 metres
C	=	forb species
D	=	grass and grass-like species
Eb	=	moss species
E1	=	lichen species

Cover Estimates of All Species: Represents the exact cover value of that species.

Biomass: Kilograms per hectare, air-dry basis.

Parent Materials

M = moraine, GF = glaciofluvial, L = lacustrine, F = fluvial, E = eolian, GL - glaciolacustrine, P = saprolite, R = rock, O = organic, v = veneer, b = blanket

APPENDIX B

PLOT DATA FOR FOREST TYPE: PINE-HAIRY WILD RYE (P1)

Plot No.	29	30	50	66	79	81	84	93	95	96	N-34	N-32	N-35	N-39
Forest Cover Type	C3P	C1P	B2P	B1P	C2P	C2 P(Sw)	C2 PSwBa	C2 P	B3 P(Sw)	B2P	A1P	B1 P(Sw)	C2 SwP	C2 PSw
Parent Material	Dy Rfs	Rb Rsm	Dy Rfs	Dy Rfs	Dy Rfs	Dy Rfs	Rb Rf	Dy Rfl	Dy Rfl	Dy Rfl	Dy Rf	Dy Rfs	Dy Rfs	Dy Rfs
Elevation (Metres)	1400	1400	1480	1780	1340	1380	1985	1630	1655	1880	1620	2080	1810	1680
Degrees Slope	18	15	30	22	24	16	4	22	24	24	17	16	5	24
Aspect	S	SW	SW	SW	SSW	SW	S	SW	SW	SW	SW	W	S	SE
Date	14/06	14/06	28/06	26/06	30/06	30/06	30/06	25/07	25/07	25/07	09/08	10/08	10/08	10/08
Biomass (kg/ha):														
Grass						346.0		386.0	220.0	242.0				248.0
Forbs						186.0		348.0	226.0	338.0				126.0
Browse														

Species		Percent Cover													Sum	F	SF	gl
A1	Pin co	35	75	50	75	55	45	30	80	25	95	10	.5	15	40	570.5	48.8	100	40.8
	Pic gl							30		.5			.5			31.0	2.2	14	0.8
A2	Pin co	20		40	5	10		3	10	3	5	20	.5	30	10	154.5	11.2	86	10.4
	Pic gl							8	.5	2	.5			30	2	43.0	3.1	43	2.0
B1	Pin co	4	3	1	5		.5		1		.5		50			65.0	4.6	57	3.5
	Pic gl	4	2			5	5	5						2	2	25.0	1.8	50	1.3
	Ala cr	2	25						.5							27.5	2.0	21	0.9
B2a	Ala cr		70				10				.5					70.5	5.0	14	1.9
	Pin co				2	2							.5	1	2	9.5	0.7	43	0.5
	Pic gl							5			2		.5		2	9.5	0.7	29	0.4
B2b	Arc uv		8		10	60						30	.5	1		109.5	7.8	43	5.1
	Ros ac	10	3				10	6	5		2	3			5	44.0	3.1	57	2.3
	Lin bo	2	8	1	1	4	10	5			2			.5	2	36.5	2.5	71	2.1
	Vac vi			.5		5	5	2								12.5	0.9	29	0.5
C	Car ca	1		.5	4	7	7	1	5		11					36.5	2.6	57	2.0
	Arn co	2			1	2	4	1	3	1	4		3	2	.5	23.5	1.7	79	1.5
	Ast co						.5		9	9	3	5				22.5	1.6	36	1.0
	Lat oc	1					1		.5	2	6				2	14.5	1.0	43	0.7
	Epi an	2		.5			3	1		.5	1		2	.5	.5	13.0	0.9	36	0.5
	Pra vi	2	3					1	6	1						13.0	0.9	36	0.5
D	Ely in	1	3		3	5	6	3	7	8	8	1	4	.5	9	61.5	4.4	93	4.2
Eb	Feathermoss	15P	14(H)	.5	2(Pt)		40(H)	80(H)	.5		2		2	40(H)	2	206.5	14.7	79	13.1
E1	Pol spp.	.5		26	.5	2	1	1	2	1	2		1	3		40.0	2.9	79	2.6

NOTE. Species with pi<0.5: Abi la, Vib ed, Dry ho, Rub st, Rib ht, Vac ca, She ca, Salix spp., Jun co, Vac mp, Led gr, Sol lu, Ger ri, Tar of, Hal ca, Vio re, Gen pr, Hit nu, Pet pe, Ane na, Gal bo, Aga au, Vic am, Del gl, Mer la, Pol vi, Pyr se, Zyg el, Ant spp., Cas el, Mer pe, Sol spa Pyr as, Hed ma, Rob bo, Fes br, Cal pu, Car spp., Bro pu, Poa spp., Cal ru, Reindeer lichen

APPENDIX C

PLOT DATA FOR PHASE TYPE: PINE-LABRADOR TEA-FEATHERMOSS (P2)

Plot No.	5	6	7	10	31	32	34	35	36	40	89	91	90	94	97
Forest Cover Type	C3 Pbw	S2 P	C3 Pbw/b	S2 P	C2 P	C2 P	C2 P	S2 P	C2 Pbw	S2 P(Sb)	C3 P(Sb)	S2 P	S2 P	C3 P	C2 SbP
Parent Material	Pv/Rr Bf1	Pv/Rr Bf1	Pv/Rr Bf1	Bp, Bm1	Pv Bf4	Pv Bf4	Bp Bf	Bp, Bm	Bp, Bm	Bp Bf	Pv Bf4	Pv Bf4	Pv Bf4	Pv Bf1	Pv Bf1
Elevation (Metres)	1630	1665	1660	1530	1520	1510	1375	1480	1375	1280	1610	1600	1400	1600	1630
Degrees Slope	5	8.5	8.5	2	8	30	-	4	2	-	5	11	16	-	12
Aspect	N	SW	NW	NW	E	S	-	E	NE	-	ENE	WNW	W	-	N
Date	08/06	08/06	09/06	10/06	16/06	16/06	16/06	16/06	16/06	16/06	24/06	24/06	08/07	25/07	25/07
Biomass (kg/ha):															
Grass				22.0		148.0		28.0	48.0						
Forbs				22.0		124.0		42.0	28.0						
Browse															

Species		Percent Cover														Sum	T	SY	pi
A1	Pin co	20	70	20	70	35	65	60	65	35	40	40	80	70	65	20	736.0	4.9	100	4.9
		5		15						35							86.0	3.7	30	1.7
A2	Pin co	7	5	10	10	15	20	10	5	3	25	10			5	10	143.0	9.5	87	8.9
	Pic gl	4		10						7				8			29.0	1.9	27	1.0
B1	Pic gl	5		5	4				2	10		10			3	1	40.0	2.7	53	2.0
	Pic ma		1		1	13								5			25.0	1.7	33	1.0
B3a	Abi la	5	2	5		8							3			10	33.0	2.2	40	1.4
	Pin co					5		5			15						25.0	1.7	20	0.8
	Sal spp.				1						25					2	28.0	1.9	20	0.8
	Pic gl			2					2	5					5		14.0	0.9	27	0.5
B3b	Led gr	10	2	15	20	25	20	45	20	25	15	40		15	15	4	442.0	29.5	93	28.4
	Vac vi		2	5	15	40	30	5	5	5	8	25	15	12	10	8	288.0	13.7	93	13.2
	Lin bo		2		.5	5	5	2	2		5	10	10	8	3	2	94.5	3.6	80	3.2
	Vac ca	10	2		10	.5	15		2	3			.5			.5	43.5	2.9	60	2.2
	Abi la	20		8						8							33.0	2.2	33	1.0
	Sal spp.		5		4			5	2	5				.5			21.5	1.4	40	0.9
	Aln cr			2					35								37.0	2.5	13	0.9
	Pic ma											20	.5		2		22.5	1.5	20	0.7
C	Cor ca	2	1		1	5	1	3	5	3	6	1	4	3	8	5	48.0	3.3	100	3.3
	Arn co		1						1				15		5	2	24.0	1.6	33	0.9
D	Ely la	.5	2				.5	.5	2	1	2		1	1	2	1	13.5	0.9	73	0.8
Eb	Feathermoss	92(H)	80	99(P)	100(Pt)	90(P)	98(P)	90(P)	98(P)	85(P-Pt)	97(H)	77(P-Pt)	40(P1)	98(H)	88(P)	96(P)	1326.0	88.4	100	88.4
El	Pol spp.	8	10	5	4		5	5	2	3	5	12	6	9	1	7	96.0	6.4	93	6.2

NOTE: Species with pi<0.5: Pop tr, Pic en, Bet gl, Ros ac, Sal la, Jun co, Rib spp., Arc uv, Biv od, Vac oy, Vac sc, Vac ma, Eqp ni, Pot pe, Rhi ca, Rhi ru, Hab spp., Cal ba, Pod gr, Ant spp., Fra vi, Ast ci, Gal bo, Epi an, Ach mi, Vio re, Equ sc, Sal spp., Rub pu, Sni st, Pyr as, Pod spp., Lyc an, Lyc co, Mer pe, Pyr sp, Str am, Lis co, Lyc ob, Equ ar, Cal re, Dry spp., Reindeer lichen

APPENDIX D

PLOT DATA FOR FORAGE TYPE: PINE-WHITE-FLOWERED RHODODENDRON-FEATHERMOSS (P3)

Plot No.		1	60	63	64	Sum	$\bar{X}$	%f	pi
Forest Cover Type		B2 P(Sw)	B2 P(Sw)	C2 PSw	B2 P				
Parent Material		Pv / Rrs	Pv / Rrs	Pv / Rrs	Pv / Rrs				
Elevation (Metres)		1630	1650	1650	1705				
Degrees Slope		12	27	22	23				
Aspect		N	N	NE	NE				
Date		04/06	24/06	26/06	26/06				
Biomass (kg/ha)									
Grass		2.0		8.0	0.0				
Forbs		48.0		40.0	66.0				
Browse									
Species		Percent Cover							
A1	Pin co	25	25	30	40	120.0	30.0	100	30.0
	Pic en	5	5			10.0	2.5	50	1.8
	Pic gl			10		10.0	2.5	25	1.3
A2	Pin co	9	10	10	3	32.0	8.0	100	8.0
	Pic gl			10	2	12.0	3.0	50	2.1
B1	Pin co	15	.5	2	3	20.5	5.1	100	5.0
	Abi la		15	2	2	19.0	4.8	75	4.2
	Pic en	5	5			10.0	2.5	50	1.8
B2a	Rho al	40	5	20	40	105.0	26.3	100	26.3
	Abi la		20	1	2	23.0	5.8	75	5.0
	Hen gl			40		40.0	10.0	25	5.0
	Pin co	15		1	5	21.0	5.3	75	4.6
	Pic en	4	5			9.0	2.3	50	1.6
	Sor sc			5		5.0	1.3	25	0.7
B2b	Vac vi	15	8	5	7	35.0	8.8	100	8.6
	Vac ca	8		5	5	18.0	4.5	75	3.9
	Lin bo	1	5	5	3	14.0	3.5	100	3.5
	Led gr	10			5	15.0	3.8	50	2.7
	Vac me		15			15.0	3.8	25	1.9
C	Pyr se	1	10			11.0	2.8	50	2.0
	Cor ca	3	2	1	2	8.0	2.0	100	2.0
	Rub pe	1	1		2	4.0	1.0	75	0.8
Eb	Feathermoss	87(P)	73(P)	60(Pt)	47(P)	267.0	66.8	100	66.8
E1	Pel spp.	.5	8	2	6	16.5	4.1	100	4.1
	Reindeer lichen	.5		1	1	2.5	0.6	75	0.5

NOTE: Species with pi<0.5: Sal spp., Lyc ob, Smi ra, Lyc co, Arn co, Lyc an, Cal ru

APPENDIX E

PLOT DATA FOR FORAGE TYPE: PINE - CANADIAN BUFFALO-BERRY - HAIRY WILD RYE (P4)

Plot No.		42	45	47	48	49	69	71	128	Sum	$\bar{X}$	Sf	pi
Forest Cover Type		D3 P	C2 P	D2 P	C2 P	D1 P	D2 P	D2 P	D3 PSw				
Parent Material		Pv/Rru	Mv/Rt	Mv/Rt	Mv/Rt	Mv/Rt	Ff1	Ff1	Pv/Rlr				
Elevation (Metres)		1360	1340	1405	1425	1425	1270	1270	1480				
Degrees Slope		6	-	3	2	-	2	2	8				
Aspect		Se	-	N	E	-	Sw	S	S				
Date		19/06	19/06	19/06	17/06	19/06	26/06	26/06	21/08				
Biomass (kg/ha):													
Grass		48.0	90.0	294.0	18.0	88.0	48.0	110.0	76.0				
Forbs		174.0	68.0	10.0	26.0	44.0	24.0	68.0	124.0				
Browse		4.7	0.0				0.0	1.0					
Species		Percent Cover											
A1	Pin co	60	40	50	40	50	35	65	50	390.0	48.0	100	48.8
A2	Pin co	20	5	30	40	10	40	5	25	175.0	21.9	100	21.9
	Pic gl						.5	5	5	10.5	1.3	38	0.8
B1	Pin co		10	2		5	.5			17.5	2.2	50	1.6
	Pic gl						5	3	2	10.0	1.3	38	0.8
B2a	She ca	40	80	20	30	10	40	30	45	295.0	36.9	100	36.9
B2b	Lin bo	10	5	10	10	20	30	.5	5	90.5	11.3	100	11.3
	Arc uv	2	35	10	10	20	.5	.5	2	80.0	10.0	100	10.0
	Ros ac	15	8	4	5	3	3	3		41.0	5.1	88	4.8
	Spi lu	10	10	2						22.0	2.8	38	1.7
	Jun co				5	5	5			15.0	1.9	38	1.2
C	Ast co	.5	9				1	13	4	27.5	3.4	63	2.7
	Fra vi	1	.5	.5	1	1	1	7	2	14.0	1.8	100	1.8
	Mer pa	6							1	7.0	0.9	25	0.5
	Arn co				2				3	6.0	0.8	38	0.5
	Ast ci			.5	2	2		1		5.5	0.7	50	0.5
D	Ely in		5	4	5	4	4	5	1	29.0	3.6	100	3.6
Eb	Feathermoss	60(H)	1(H)	3(H)	4(H)	.5(H)	22(H)	67(H)	77(H)	234.5	29.3	100	29.3
Eb	Pel spp.	3	4	.5	2	.5	1	1	2	14.0	1.8	100	1.8

NOTE: Species with pi<0.5: Pop tr, Sal spp., Pot fr, Vac vi Vac ca, Ach mi, Car ca, Pyr vi, Sal spp., Cas mi, Epi an, Lat oc, Pyr se, Vic am, Gal bo, Pyr as, Pet pa, Cal bu, Zyg el, Ant spp., Car spp., Bro pu, Cal ru, Oxy pa, Reindeer lichen

APPENDIX F

PLOT DATA FOR FORAGE TYPE: PINE-COMMON BEARBERRY (P5)

Plot No.	74	75	77	H-22
Forest Cover Type		C1P	A1P	C1P
Parent Material	$\frac{Pv}{Rt}$	Ft-Fui	Ft-Fui	Rsr
Elevation (Metres)	1390	1380	1400	1740
Degrees Slope	2			19
Aspect	S			E
Date	26/06	26/06	26/06	09/08
Biomass (kg/ha)				
Grass	82.0	80.0	196.0	0.0
Forbs	54.0	28.0	102.0	0.0
Browse				

Species		Percent Cover			Sum	$\bar{X}$	%f	pi
A1	Pin co		35	8	65	108.0	27.0	75	23.4
	Pin fl	4				4.0	1.0	25	0.5
A2	Pin co		45	5		50.0	12.5	50	8.8
	Pin fl	12				12.0	3.0	25	1.5
B2a	She ca		10	10		20.0	5.0	50	3.5
	Pot fr			7		7.0	1.8	25	0.9
B2b	Arc uv	30	50	40		120.0	30.0	75	26.0
	Ros ac		8	12		20.0	5.0	50	3.5
	Pot fr		6	5		11.0	2.8	50	2.0
	Jun ho	15							
E	Ely in	.5	1	1		2.5	0.6	75	0.5

NOTE: Species with pi < 0.5: Pic gl, Pop tr, Pic gl, Sal spp., Ane mu, Sen ca, Asr al, Fra vi, Ant ni, Oxy ca, Hed su, Ast ci, Cam ro, Koe cr, Bro in, Bro pu, feathermoss

NOTE: Asr = Astragalus

APPENDIX G

PLOT DATA FOR FORAGE TYPE: PINE-BLACK SPRUCE-FEATHERMOSS (P6)

Plot No.	13	15	33	78	80	123	126
Forest Cover Type	C2 P	D2 PSb	C2 SbP	D2 PSb	D2 PSb(Sw)	C2 P b	C2 PSb
Parent Material	Pv / Rfr	Mv / Rf	Pv / Rrs	Pv / Rrs	Pv / Rrs	Mvb / Rmf	Fu
Elevation (Metres)	1660	1540	1425	1290	1300	1620	1505
Degrees Slope	9	-	2	5	3	7	-
Aspect	Sw	-	Nw	E	Sw	S	-
Date	08/06	09/06	16/06	28/06	28/06	20/08	20/08
Biomass (kg/ha):							
Grass	2.0	0.0	0.0	14.0	58.0	58.0	182.0
Forbs	24.0	30.0	30.0	70.0	36.0	70.0	156.0
Browse							

Species		Percent Cover							Sum	$\bar{X}$	%f	pi
A1	Pin co	25	15	20	55	20	36	25	196.0	28.0	100	28.0
	Pic ma	10	.5	30					45.0	6.4	43	4.2
A2	Pic ma	15	35	5	5	25	20	25	130.0	18.6	100	18.6
	Pin co	5			10	10			25.0	3.6	43	2.4
B1	Pic ma		25	5	10	5	3	15	63.0	9.0	86	8.3
	Pic gl					10			10.0	1.4	14	0.5
B2a	Pic ma	4	2	10	5	2		15	38.0	5.4	86	5.0
	Abi la			2		2	5		9.0	1.3	43	0.9
B2b	Led gr	15		20	40			3	78.0	11.1	67	9.1
	Vac vi	20	8	5	8	20		3	64.0	9.1	86	8.4
	Lin bo	10				8	5	2	33.0	4.7	71	4.0
	Vac ca	11		2					13.0	1.9	29	1.0
	Ros ac					3		4	7.0	1.0	29	0.5
C	Cor ca	4	5	2	8	3	5	5	32.0	4.6	100	4.6
	Pet pa	.5			.5	2	1	2	6.0	0.9	71	0.8
D	Ely in	1			2	6	3	4	16.0	2.3	71	1.9
Eb	Feathermoss	73(Pt)	93(Pt)	95(P)	97(P)	89(H)	80(P)	100(Pt)	627.0	89.6	100	89.6
E1	Pel spp.	16	9	9	8	13	5		60.0	8.6	86	8.0

NOTE: Species with pi<0.5: Sal spp., Jun co, Ast ci, Pyr se, Mit nu, Lyc an, Arn co, Ach mi, Epi an, Mer pa, Fra vi, Cal ru. Shagnum, Reindeer lichen.

APPENDIX H

PLOT DATA FOR FORAGE TYPE: PINE-WILLOW-FEATHERMOSS (P7)

Plot No.	12	57	66	82
Forest Cover Type	C3 PSw	B2P SbPSw	C2 P	B3 P(Sw)
Parent Material	Mb Ru1	Pv Rfs	Pv Rfs	Pv Rfs
Elevation (Metres)	1515	1495	1710	1480
Degrees Slope	-	1	22	7
Aspect	-	N	S	NE
Date	08/06	24/06	26/06	28/06
Biomass (kg/ha)				
Grass	48.0	148.0	144.0	
Forbs	24.0	364.0	268.0	
Browse	14.6	2.6	4.1	

Species		Percent Cover				Sum	$\bar{X}$	%f	pi
A1	Pin co	5	35	55	20	115.0	28.8	100	28.8
	Pic gl	15		1	5	21.0	5.3	75	4.6
A2	Pin co	5	8	10	5	28.0	7.0	100	7.0
	Pic gl	25	2		5	32.0	8.0	75	6.9
B1	Pic gl	15	3		10	28.0	7.0	75	6.1
	Pin co		7	15	5	27.0	6.8	75	5.9
	Sal spp.	10				10.0	2.5	25	1.3
B2a	Sal spp.		15	4	75	94.0	23.5	75	20.4
	Pin co		20	5	5	30.0	7.5	75	6.5
	Led gr				25	25.0	6.3	25	3.2
	She ca	20				20.0	5.0	25	2.5
	Pic gl	5	5						
	Bet gl		5	4	5				
	Rib la								
B2b	Lin bo	8		3	15	26.0	6.5	75	5.6
	Vac vi	2	5	4	5	16.0	4.0	100	4.0
	Vac ca	1	2	3	5	11.0	2.8	100	2.8
	Pic gl	6				6.0	1.5	25	0.8
	Vac me				5	5.0	1.3	25	0.7
	Jun co	1		2		3.0	0.8	50	0.6
C	Mer pa	1	.5	2	4	7.5	1.9	100	1.9
	Cor ca	1	.5	4	2	7.5	1.9	100	1.9
	Rub ac		2		5	7.0	1.8	50	1.3
	Arn co	2	1	1	2	6.0	1.5	100	1.5
	Epi an	.5	.5	.5	3	4.5	1.1	100	1.1
	Pet pa		1	.5	3	4.5	1.1	75	1.0
	Fra vi	3	.5	.5		4.0	1.0	75	0.9
	Mit nu		2	1	1	4.0	1.0	75	0.9
	Ach mi		1	1	1	3.0	0.8	75	0.7
	Del gl			1	3	4.0	1.0	50	0.7
D	Ely in	2	3	3	.5	8.5	2.1	100	2.1
	Cal ru		1	1	6	8.0	2.0	75	1.7
Eb	Feathermoss	61(H)	80(H)	55(Pl)	50	246.0	61.5	100	61.5
	Sphagnum				16	16.0	4.0	25	2.0
E1	Pel spp.	3	2	1	6	12.0	3.0	100	3.0

NOTE: Species with pi <0.5: Aln cr, Led gr, Ros ac, Sal spp., Rib spp., Abi la, Ast ci, Pol pu, Ast spp., Lat oc, Cal bu, Pyr se, Gal bo, Equ ar, Hed ma, Str am, Her la, San tr, Par fi, Pyr as, Lyc ob, Rub ch, Rub pe, Equ sc, Car spp., Luz pa

APPENDIX I

PLOT DATA FOR FORAGE TYPE LODGEPOLE PINE-BOG CRANBERRY-FEATHERMOSS (PB)

Plot No.		8	15	16	34	38	53
Parent Material		Cv / R	Cvb / R	Cvb / R	Cvb / R	Cvb / R	Cvb / R
Degrees Slope		37	16	16	30	27	13
Elevation (metres)		1490	1620	1515	1715	1540	1520
Aspect		NE	N	E	N	NNE	E
Forest Cover Type		D2P	C1P	C2P	DwP(Sw)	D2PSw	D2P(Sw)
Date		06/06	07/06	07/06	09/06	29/06	18/06
Biomass (kg/ha):							
Grass		14			14	6	20
Forbs		8			20	34	20
Browse							

Species		Percent Cover						Sum	$\bar{X}$	%f	pi
A1	Pin co	45.0	10.0	55.0	40.0	10.0	40.0	200.0	33.3	100	33.3
	Pic gl	15.0		5.0		5.0		25.0	4.2	50	3.0
A2	Pin co	5.0	20.0	10.0	20.0	20.0	20.0	95.0	15.8	100	15.8
	Pic gl	5.0				35.0		40.0	6.7	33	3.8
B1	Aln cr		25.0					25.0	4.2	17	1.7
	Pic gl		3.0					18.0	3.0	33	1.7
	Pic ma		1.0			5.0		6.0	1.0	33	0.6
B2a	Pic gl	2.0	5.0	3.0	5.0		5.0	20.0	3.3	83	3.0
	She ca				6.0		6.0	12.0	2.0	33	1.1
	Sal spp.				5.0		5.0	10.0	1.7	33	1.0
B2b	Vac vi	35.0	20.0	15.0	15.0	10.0	15.0	110.0	18.3	100	18.3
	Led gr	5.0	1.0	15.0	3.0	15.0	3.0	42.0	7.0	100	7.0
	Lin bo	10.0	3.0	5.0	5.0	2.0	5.0	30.0	5.0	100	5.0
	Jun co	15.0						15.0	2.5	17	0.6
	Emp ni					10.0		10.0	1.7	17	0.7
	Pic gl			3.0				8.0	1.3	33	0.7
	Vac ca			3.0	1.0		1.0	5.0	0.8	50	0.6
D	Ely in	0.5	2.0	1.0			1.0	4.5	0.8	67	0.7
Eb	F moss	75.0	95.0	100.0	38.0	99.0	38.0	445.0	74.2	100	74.2
EL	Pel spp.	2.0	1.0	3.0		5.0		11.0	1.8	67	1.5
	Lichen		0.5	0.5	2.0		2.0	5.0	0.8	67	0.7

NOTE: Species with pi <0.5: Ros ac, Pyr se, Pyr as, Arn co, Ste ac, Ast ei, Epi an, Hab ob, Cor ca, Lyn an, Poa spp., Bro spp., Ory pu

NOTE: Data taken from Ram-Clearwater Study (1982).

APPENDIX J

PLOT DATA FOR FORAGE TYPE: WHITE SPRUCE-BOG CRANBERRY-FEATHERMOSS (Sw1)

Plot No.		4	30	62	119	120	H-10	H-12	H-36	H-41				
Forest Cover Type		B3 SwP	C3 SwPb	C3 SwP	C2 Sw	C3 Sw	A2Sw / BoPbSw	C2 Sw	B2 Sw	C2 Sw(P)				
Parent Material		Pv / Rrs	Pv / Rrs	Pv / Rrs	Pv / RTr	Pv / RTr	Rrs	Rrs	Pv / Rrs	Pv / Rrs				
Elevation (Metres)		1450	1500	1520	1890	1740	2005	2000	1810	1885				
Degrees Slope		10	27	18	31	25	5	18	15	24				
Aspect		W	N	E	E	NE	NE	W	NW	NW				
Date		04/06	28/06	24/06	21/08	21/08	09/08	09/08	10/08	10/08				
Biomass (kg/ha):														
Grass					54.0	90.0	0.0	10.0	0.0	86.0				
Forbs					30.0	32.0	0.0	22.0	0.0	32.0				
Browse					0.0	0.0								
Species		Percent Cover									Sum	X	sf	pi
A1	Pic gl x en	10	30	35	40	40	10	70	30	35	300.0	33.3	100	33.3
	Pin co	10	1	10						5	26.0	2.9	44	1.9
	Abi la	5	5	15							25.0	2.8	33	1.6
A2	Pic gl x en	10	30	.5	20	15	3	5	40	3	126.5	14.1	100	14.1
	Abi la		15	10		5	3				33.0	3.7	44	2.5
	Pin co	5	2							2	9.0	1.0	33	0.6
B1	Pic gl x en	5	2		15		30	1	5	10	68.0	9.7	78	8.6
	Abi la	.5		5		5	10				20.5	2.3	44	1.5
B2a	Pic gl x en	8	5	.5	2		20	1	8		44.5	4.9	78	4.3
	Abi la	3	4	15		2	10	1	2		37.0	4.1	78	3.6
	Sal spp.	3					10		15	8	36.0	4.0	44	2.7
B2b	Vac vi	30	25	5						5	65.0	7.2	44	4.8
	Led gr	15	5	2							22.0	2.4	33	1.4
	Lin bo	4	2	1	5	3				1	15.0	1.7	44	1.1
	Abi la					5	5	1			11.0	1.2	33	0.7
	Jun co				10		.5				10.5	1.2	22	0.6
C	Arn co	2		6	8	3		5	1	.5	25.5	2.8	78	2.5
	Cor ca	6	1	5		3					15.0	1.7	44	1.1
D	Ely in	3			6	6		2	2	7	26.0	2.9	67	2.4
Eb	Feathermoss	95	80(H)	96	60(H)	90(H)	82(H)	94(P)	100(Pt)	41(P)	738.0	82.0	100	82.0
E1	Pel spp.	7	5	9	13	7	8	3	6	18	76.0	8.4	100	8.4

NOTE: Species with pi < 0.5: Ros ac, Rib la, Vac me, Vac sc, Cas te, Epi an, Ach mi, Mer pa, Pet pa, Equ ar, Mit nu, Gal bo, Pyr se, Str am, Lis co, Sal spp., Ast ci, Equ sc, Pod br, Gen spp., Sen pa, Mon un, Pol vi, Cer ar, Luz pa, Pyr as, Sen tr, Ane qu, Cal ru, Poa spp., Car spp.

APPENDIX K

PLOT DATA FOR FORAGE TYPE: WHITE SPRUCE-FEATHERMOSS (Sw2)

Plot No.	41	44	51	107	108	109
Forest Cover Type	C2 Sw(P)	C3 SwFb(P)	C3 Sw	D3 PSw	C3 P(Sw)	C3 PSw
Parent Material	Mv / RP	Pv / Rfs	Mb / Rt	Pv / Rfl	Pv / Rfl	Mv-c / Rt
Elevation (Metres)	1360	1590	1410	1230	1315	1220
Degrees Slope	-	2	-	21	7	-
Aspect	-	Sw	-	N	N	-
Date	19/06	28/06	28/06	10/07	12/08	10/07
Biomass (kg/ha):						
Grass	294.0	232.0		12.0	4.0	52.0
Forbs	20.0	314.0		26.0	70.0	38.0
Browse				0.6	0.0	

Species		Percent Cover						Sum	$\bar{X}$	sf	pi
A1	Pic gl	40	35	45	25	30	20	195.0	32.5	100	32.5
	Pin co		5		25	20	40	90.0	15.0	67	12.3
A2	Pic gl	25	45	50	15	15	7	157.0	21.2	100	21.2
	Pin co		1	5		5	3	14.0	2.3	67	1.9
	Pic ma	25						25.0	4.2	17	1.7
B1	Pic gl	15	5	15	5	5	5	50.0	8.3	100	8.3
	Abi la		25					25.0	4.2	17	1.7
B2a	Rib spp.		10		2			12.0	2.0	33	1.1
	Sal spp.		10		2			12.0	2.0	33	1.1
	Pic gl				1		5	6.0	1.0	33	0.6
B2b	Lin bo	40	5		4	3	5	57.0	9.5	83	8.7
	Led gr		40			2		42.0	7.0	33	4.0
	Ros ac				1		10	11.0	1.8	33	1.0
	Vac vi		2	1		1	3	7.0	1.2	67	1.0
C	Cor ca		6			2	1	11.5	1.9	83	1.7
	Mer pa		9	.5				9.5	1.6	33	0.9
	Arn co	3	2	.5	2		.5	5.5	0.9	50	0.6
	Fra vi	5		.5				5.5	0.9	33	0.5
	Pet pa		.5	.5		3		4.0	0.7	50	0.5
D	Ely in	3	1	.5	.5	1	2	8.0	1.3	100	1.3
Eb	Feathermoss	30(H)	60 (H)	80(H)	100(H)	100(P)	100(H)	470.0	78.3	100	78.3
El	Pel spp.	9	7	2		1	2	21.0	3.5	83	3.2

NOTE: Species with pi<0.5: She ca, Vib ed, Lon di, Sal spp., Arc uv, Vac ca, Mit nu, Ast ci, Epi an, Equ ar, Rub ac, Rub pu, Equ sc, Pol pu, Hab spp., Pyr se, Zyg el, Ach mi, Lat co, Mit nu, Gal bo, Jun spp., Car spp.

APPENDIX L

PLOT DATA FOR FORAGE TYPE: WHITE SPRUCE-CANADIAN BUFFALO-BERRY-HAIRY WILD RYE (Sw3)

Plot No.		16	18	20	23	24	25	27	43	46	68	72	105	115
Forest Cover Type		C1 Aw/P	S2 Sw(A)	C2 Sw	C1 Sw(P)	S3 Sw	C2 A(Sw)	C1 Sw(P)	C1 Sw/P	A0 Sw/P	C1 Sw/P	S3 Sw/P	C2 Sw	S3 Pl/w
Forest Material		Dy Sf	Dy Sm	Dy Sm	Dy Sf	Dy Sm	Dy Sm	Dy Sf	Dy Sm	Dy Sf	FFl	FFl	Dy Sm	Dy Sf
Elevation (Metres)		1360	1160	1360	1405	1400	1400	1400	1360	1360	1360	1360	1360	1400
Biomass (kg/ha):														
Gross		98.0	250.0			98.0	248.0	136.0	148.0	236.0		220.0	76.0	
Forbs		148.0	86.0			132.0	198.0	670.0	68.0	72.0		142.0	144.0	
Browse		0.0	1.5							1.8				
Species							Percent Cover							
A1	Pic gl	25	30	50	35	45	10	30	15	2	20	5	35	35
	Pop tr	35						20						
	Pin co	5		5				5	5		10	.5		
A2	Pic gl	3	20	10	5	55	10	.5	10	2	25	20	30	30
	Pop tr	3		10	40			15	15		5		60	60
	Pin co						.5		5	1	5	5		
	Pop ba						10	10						
B1	Pic gl		7		2		55	5	10	5	5	25	3	3
	Sal spp.		10					5	1				2	2
	Pop tr				2			.5	10	2			3	3
	Pop ba	10					5	5		3				
B2a	Shr ca	10	40	30	35	25	5	35	30	5	40	80	40	40
	Pic gl	65		2				10		8	5			
	Sal spp.	2	12					10					3	
	Pop tr	2		4				5		8	.5			
	Ros ac		3			5		5						3
	Pop ba	2			5					10				
B2b	Arc uv	5	80	2				.5	3	80	5			2
	Ros ac	5	25	10	2	8	2		12	3	5	5		
	Lin bo	2	5		3	2		5	5		10	5		
	Jun ho		20							5			.5	.5
C	Pre vi	7		5	.5	2	2	12	2	2	1		1	1
	Ast co	4				1	.5	10	2		3	18		
	Lat ac	2		1	2		.5	5					4	4
	Ver sc	8			.5		2	6						
D	Ely in	12	2	3	8	1	3	6	3	5	1	13	1	1
	Car spp.		10	.5		.5	.5	1	.5	1	1		.5	.5
Eb	Feathermoss	9(Pt)	30	40(P)	4(P)	82	10(P)	61(P)	25(H)		46(P)	84(H)	80(P)	8(H)
El	Pol spp.	.5	.5	.5		12		1	2		1			1

	Sum	T	Sf	pl
A1	327.0	25.2	100	25.2
	60.0	4.6	23	2.2
	36.5	2.7	84	2.0
A2	215.5	16.6	100	16.6
	147.0	11.3	62	8.9
	16.5	1.3	38	0.8
	20.0	1.5	15	0.6
B1	135.0	10.4	77	9.1
	31.0	2.4	38	1.8
	22.5	1.7	46	1.2
	23.0	1.8	31	1.0
B2a	385.0	29.6	100	29.6
	98.0	7.5	46	5.0
	29.0	2.2	31	1.2
	19.5	1.5	38	0.9
	16.0	1.2	31	0.7
	17.0	1.3	23	0.6
B2b	157.5	12.1	62	9.5
	77.0	5.9	77	5.2
	37.0	2.8	62	2.2
	29.5	2.3	31	1.3
C	36.0	2.7	85	2.5
	36.5	2.8	54	2.1
	16.5	1.3	54	1.0
	16.5	1.3	31	0.7
D	66.0	5.1	100	5.1
	15.5	1.2	69	1.0
Eb	448.0	34.5	92	33.1
El	18.5	1.4	62	1.1

NOTE: Species with pl<0.5: Pic mu, Pot fr, Lon in, Vib ed, Amp al, Abi la, Jun co, Vac ca, Vac vi, Equ ar, Arn co, Pyr sa, Epi an, Rub pu, Zyg el, Ach mi, Gal bo, Ast ci, Hod nu, Ane mu, Lil ph, Hab ob, Pyr as, Del gl, Cas mi, Hed el, Vic am, Tri spp., Gen 11, Hed spp., Ran spp., Sau ar, Pet pa, Oxy ca, Pyr vi, Rit mu, Cor ca, Equ sc, Cal spp., Bro spp., Ory pu, Reindeer lichen

APPENDIX H

PLOT DATA FOR FORAGE TYPE: WHITE SPRUCE - HAIRY WILD RYE (Sw4)

Plot No.	85	86	88
Forest Cover Type	B3 SwP	C2 SwP	B2 Sw(P)
Parent Material	Rhb / Rmt	Rhb / Rmt	Fv / Rfs
Elevation (Metres)	1525	1555	1515
Degrees Slope	12	12	12
Aspect	S	SW	S
Date	06/07	06/07	30/06
Biomass (kg/ha)			
Grass	134.0	14.0	70.0
Forbs	356.0	72.0	130.0
Browse	0.0	1.4	

Species		Percent Cover			Sum	$\bar{X}$	sf	pi
A1	Pic gl	25	50	30	105.0	35.0	100	35.0
	Pin co	5	5	10	20.0	6.7	100	6.7
	Abi la		5		5.0	1.7	33	1.7
A2	Pic gl	10	3	35	48.0	16.0	100	16.0
	Pin co		3	15	18.0	6.0	67	4.9
	Abi la		3		3.0	1.0	33	0.6
B1	Pic gl	8	5		13.0	4.3	67	3.5
	Abi la	2	5		7.0	2.3	67	1.9
B2a	She ca	5		10	15.0	5.0	67	4.1
	Abi la	2	3		5.0	1.7	67	1.4
	Pic gl	3	2		5.0	1.7	67	1.4
	Ros ac			5	5.0	1.7	33	1.0
	Sal spp.	3			3.0	1.0	33	0.6
B2b	Lin bo	3	2	20	25.0	8.3	100	8.3
	Ros ac	4	5	8	17.0	5.7	100	5.7
	Abi la	2	3	.5	5.5	1.8	100	1.8
	Rib spp.		5		5.0	1.7	33	1.0
	Vac vi	3			3.0	1.0	33	0.6
C	Cor ca	5	3	5	13.0	4.3	100	4.3
	Hit nu	3	1	.5	4.5	1.5	100	1.5
	Pet pa	2	.5	2	4.5	1.5	100	1.5
	Fra vi	2		1	3.0	1.0	67	0.8
	Arn co	.5	.5	1	2.0	0.7	100	0.7
	Mer pa	1	.5	.5	2.0	0.7	100	0.7
	Ast co			3	3.0	1.0	33	0.6
D	Ely in	4	1	2	7.0	2.3	100	2.3
Eb	Feathermoss	90(H)	95	25(H)	210.0	70.0	100	70.0
E1	Pel spp.	2	2	.5	4.5	1.5	100	1.5

NOTE: Species with pi<0.5: Pop tr, Vib ed, Rub pe, Cal bu, Epi an, Pyr as, Lat oc, Ast ci, Gal bo

APPENDIX N

PLOT DATA FOR FORAGE TYPE: ENGELMANN SPRUCE - ALPINE FIR - YELLOW HEATHER (Sel)

Plot No.	118	H-30	H-38
	C2	Do	B2
Forest Cover Type	Sw	Sw(P)	SwP
Parent Material	Pv RTr	Rrs	Rrs
Elevation (Metres)	1990	2100	2040
Degrees Slope	11	22	20
Aspect	N	N	NE
Date	21/08	10/08	10/08
Biomass (kg/ha)			
Grass	158.0	8.0	
Forbs	230.0	12.0	
Browse	0.0		

Species		Percent Cover			Sum	$\bar{X}$	sf	pi
A1	Pic en	25	5	40	70.0	23.3	100	23.3
A2	Abi la	5	50	6	61.0	20.3	100	20.3
	Pic en	.5		4	4.5	1.5	67	1.2
B1	Abi la	2	60	5	67.0	22.3	100	22.3
B2a	Abi la	15		5	20.0	6.7	67	5.5
	Pic en	3			3.0	1.0	33	0.6
B2b	Phy gl	60	85	70	215.0	71.7	100	71.7
	Sal spp.	10	7	3	20.0	6.7	100	6.7
	Cas te	1		15	16.0	5.3	67	4.3
	Abi la		1	3	4.0	1.3	67	1.1
	Dry ho			3	3.0	1.0	33	0.6
C	Ast ci	7		3	10.0	3.3	67	2.7
	Ped br		.5	8	8.5	2.8	67	2.3
	Sen pa	3	.5	3	6.5	2.2	100	2.2
	Pol vi	1	.5	1	2.5	0.8	100	0.8
	Ped ca	4			4.0	1.3	33	0.7
	Aqu br	3			3.0	1.0	33	0.6
	Par pa	3			3.0	1.0	33	0.6
D	Ely in	8	.5		8.5	2.8	67	2.3
Eb	Feathermoss		74	48	122.0	40.7	67	33.3
El	Pel spp.	9	20	6	35.0	11.7	100	11.7
	Reindeer lichen			3	3.0	1.0	33	0.6

NOTE: Species with pi<0.5: Sib pr, Sol spp., Her pa, Pyr se, Equ sc, Gen spp., Ran spp., Pot di, Ach mi, Ron un, Poa spp.

APPENDIX O

PLOT DATA FOR FORAGE TYPE: BLACK SPRUCE - FEATHERMOSS (Sb1)

Plot No.	8	11	14	19	22	52
Forest Cover Type	C1 Sb	Bo Sb	A1 SbP	D1 Sb	C1 Sb	D2 Sb(P)(Fb)
Parent Material	Mv RT	Mb Rul	Mv RT	Pv RFl	Mv RT	Mb RT
Elevation (Metres)	1510	1510	1540	1400	1450	1440
Degrees Slope	11	-	2	3	-	-
Aspect	NE	-	-	W	-	-
Date	09/06	08/06	08/06	10/06	22/06	28/06
Biomass (kg/ha)						
Grass		126.0				0.0
Forbs		60.0				16.0
Browse						

Species		Percent Cover						Sum	$\bar{X}$	sf	pi
A1	Pic ma	60	5		70	30	30	195.0	32.5	83	29.6
	Pin co			3	4		5	12.0	2.0	50	1.4
A2	Pic ma		20	20	5	30	45	120.0	20.0	83	18.2
B1	Pic ma	40	40	40	5		60	185.0	30.8	83	28.1
B2a	Sal spp.		30	20	15	7	1	73.0	12.2	83	11.1
	Pic ma	15		15			10	40.0	6.7	50	4.7
	Bet gl		2	5				7.0	1.2	33	0.7
B2b	Lad gr	10	20	15			20	75.0	12.5	67	10.2
	Vac vi	5	10	10			20	45.0	7.5	67	6.1
	Bet gl	12	5					17.0	2.8	33	1.6
	Sal spp.	3	10					13.0	2.2	33	1.3
	Lin bo	2			3		2	7.0	1.2	50	0.8
	Pic ma		5		1			6.0	1.0	33	0.6
	Vac ca						8	8.0	1.3	17	0.5
C	Equ spp.		1	.1	3			5.0	0.8	50	0.6
D	Car spp.	5	5		3	6		19.0	3.2	67	2.6
	Jun spp.	5		2	.5	5		12.5	2.1	67	1.7
	Ely in	.5		.5	3		.5	4.5	0.8	67	0.7
	Cal ru			4		.5		4.5	0.8	33	0.5
Eb	Feathermoss	65(H)	65(P)	85(H)	85(H)	31	80(Pt)	411.0	68.5	100	68.5
	Sphagnum	18	50	2				70.0	11.7	50	8.3
E1	Pel spp.	1	5	2	3		4	15.0	2.5	83	2.3

NOTE: Species with pi < 0.5: Abi la, Pot fr, Rib tr, Ros ac, Pot spp., Rib spp., Kal po, Cas te, Oxy mi, Pet pa, Mer pa, Hit nu, Fra vi, Epi an, Hab ob, Cor tr, Equ sc, Ped gr, Ach mi, Ste oc, Cop tr, Zyg el, Cor ca, Pot gr, Arn co, Pyr as, Ane qu, Equ ar, Des ca, Reindeer lichen

APPENDIX P

PLOT DATA FOR FORAGE TYPE: ASPEN-CANADIAN BUFFALO-BERRY-HAIRY WILD RYE (A1)

Plot No.	73	102	113	114	129	H-27
Forest Cover Type	C1 A	C1 ASw	B2 ASw	C2 A	C2 A(Sw)	B2 A(Sw)
Parent Material	Fv / RT	Fv / Rrs	Rv/Fv / Rur	Rv / R	Fv / RTr	FFl
Elevation (Metres)	1480	1480	1375	1370	1330	1450
Degrees Slope	-	13	2	-	-	-
Aspect	-	E	S	-	-	-
Date	26/06	28/07	14/07	14/07	20/08	09/08
Biomass (kg/ha):						
Grass	408.0	212.0	304.0	444.0	212.0	296.0
Forbs	82.0	64.0	148.0	166.0	414.0	170.0
Browse	0.0		0.0	16.7		

Species		Percent Cover						Sum	X	Sf	pi
A1	Pop tr			30	65	30	60	185.0	30.8	67	25.2
	Pic gl		5	5	2		2	14.0	2.3	67	1.9
A2	Pop tr	80	50	10		50		200.0	33.3	67	27.3
	Pic gl	1	10	5				16.0	2.7	50	1.9
B1	Pop tr		6	10		45		61.0	10.2	50	7.2
	Pic gl		30		5		5	40.0	6.7	50	4.7
	Sal spp.		2			4		6.0	1.0	33	0.8
B2a	Sha ca	20	10	5	25		25	85.0	14.2	83	12.9
	Pic gl		15		2	5	4	26.0	4.3	67	3.5
	Pop tr	1		5		10		16.0	2.7	50	1.9
	Sal spp.		1		2	1		4.0	0.7	50	0.5
B2b	Ros ac	15	10	5	5	5	5	45.0	7.5	100	7.5
	Arc uv		1		.5		30	31.5	5.3	50	3.7
	Sym al		2	3		2		7.0	1.2	50	0.8
C	Fra vi		3	2	3	.5	7	16.5	2.6	83	2.4
	Lat oc		4	4	3	.5	2	13.5	2.3	83	2.1
	Pet pa					25		25.0	4.2	17	1.7
	Ast ci	2		.5		9		11.5	1.9	50	1.3
	Gal bo	.5	.5	2	1	.5	1	5.5	0.9	100	0.9
	Ach mi	.5	.5	.5			4	5.5	0.9	67	0.7
	Vic am			2	1	1	1	5.0	0.8	67	0.7
	Smi st		.5			7		7.5	1.3	33	0.7
	Ast co	2			1	5	4	6.0	1.0	33	0.6
	Mer pa							6.0	1.0	33	0.6
	Oxy ca	.5					4	4.5	0.8	33	0.5
	Ane mu	.5			.5	4	4	4.5	0.8	33	0.5
	Epi an							4.5	0.8	33	0.5
D	Ely in	1	2	5	8	2	9	27.0	4.5	100	4.5

NOTE: Species with pi < 0.5: Pin co, Pin fl, Pop ba, Jun co, Jun ho, Spi lu, Pot fr, Ast la, Asr al, Cas mi, Pyr sa, All ca, Tar of, Cor tr, Pol pu, Zyg el, Hed sa, Equ ar, Equ sc, Pyr as, Tha ve, Ago gl, Vio ad, Agr da, Bro pu, Cal ne, Poa spp., Agr su, Feathermoss

NOTE: Asr = Astragalus

APPENDIX Q

PLOT DATA FOR FORAGE TYPE: SHRUB BIRCH-SEDGE (B1)

Plot No.	2	9	26	39	53	67	83	89	124	125
Forest Cover Type										Ao Sb
Parent Material	Rb RT	Rb MG	Rv MF	Rb MG	Cv MFG	Rb RT	Fu	Rbb Mmt	Rbb Mmt	Rv MF
Elevation (Metres)	1390	1460	1340	1380	1429	1480	1475	1390	1585	1490
Degrees Slope	2	-	-	-	2	-	-	-	-	-
Aspect	NW	-	-	-	S	-	-	-	-	-
Date	08/06	08/06	22/06	16/06	24/06	26/06	30/06	06/07	20/08	20/08
Biomass (kg/ha):										
Grass			1424.0		196.0	414.0	256.0		222.0	256.0
Forbs			28.0		186.0	94.0	50.0		74.0	10.0
Browse			6.8						1.8	2.4

Species		Percent Cover										Sum	X	SF	pi
A1															
A2															
B1	Pic ma	2	5	5			1			5	2	21.0	2.1	70	1.8
B2a	Bet gl	30	35		15	60	20	40	55	25	5	285.0	28.5	90	27.0
	Sal spp.	40	25	40		5	40	5	45	10		212.0	21.0	80	18.8
	Pic ma	1	8		5					10	2	26.0	2.6	50	1.8
	Lar la									10	5	15.0	1.5	20	0.7
B2b	Sal spp.	25	25	40	.5		7		5	5	5	112.5	11.3	80	10.0
	Bet gl		35				3		5	5	10	58.0	5.8	50	4.1
	Pic ma		8								5	13.0	1.3	20	0.6
C	Rub ac	1			.5	1		.5	2	3		8.0	0.8	60	0.6
D	Car spp.	2	9	38	16	7	3	12	4	11	8	110.0	11.0	100	11.0
	Jun spp.			.5	5	1		5		6	1	18.5	1.9	60	1.5
	Cal ca					.5	9			3		12.5	1.3	30	0.7
Eb	Feathermoss	22	26	31	13	40	28	20	31.5	42	45	298.5	29.9	100	29.9
	Sphagnum	22	53		73	2		1	47	48		246.0	24.6	70	20.6
E1	Pol spp.	7	1			.5	.5					9.0	0.9	40	0.6

NOTE: Species with pi<0.5: Pin co, Pic gl, Pot fr, Lar la, Rib am, Lin bo, Lod gr, Hit nu, Gal bo, Equ ar, Sal tr, Pol vi, Pod gr, Fra vi, Pol spp., Mer pa, Geu ri, Epi an, Ach mi, Rib spp., Rub ab, Pot pa, Bal gl, Ast spp., Geu tr, Val se, Vio ad, Ast ci, Mai ca, Pot pa, Poa spp., Ely in, Bas ca, Bro pu

APPENDIX R

PLOT DATA FOR FORAGE TYPE: DWARF BIRCH - HAIR GRASS (B2)

Plot No.	55	56	H-11	H-33
Forest Cover Type	☁	☁	☁	☁
Parent Material	Pv / Rrs	Pv / Rrs	Rrs	Mv / Rtu
Elevation (Metres)	1485	1490	1930	1650
Degrees Slope	-	-	1	-
Aspect	-	-	NE	-
Date	28/06	24/06	09/08	10/08
Browse (kg/ha)				
Grass	220.0		118.0	388.0
Forbs	244.0		340.0	260.0
Browse	45.5			

Species		Percent Cover				Sum	X	%f	pi
B2a	Sal spp.	20		55					
	Bet gl	10			40	75.0	18.8	50	13.3
						50.0	12.5	50	8.8
B2b	Sal spp.	15	20	10	10				
	Bet gl	30	10			55.0	13.8	100	13.8
	Pot fr	5	5			40.0	10.0	50	7.1
						10.0	2.5	50	1.8
C	Ast ci	2	4	10					
	Ach mi	.5	4	3	4	16.0	4.0	75	3.5
	Tha ve	2	6	1	2	11.5	2.9	100	2.9
	Del gl	1	5	1	1	11.0	2.8	100	2.8
	Ger spp.			11		8.0	2.0	100	2.0
	Gal bo	2	2	.5	1	11.0	2.8	25	1.4
	Pot di	.5	2	1	2	5.5	1.4	100	1.4
	Fra vi	2	3	1		5.5	1.4	100	1.4
	Geu ra	8				6.0	1.5	75	1.3
	Her pa	1	2		1	8.0	2.0	25	1.0
	Rub ac	1	1		1	4.0	1.0	75	0.9
	Ant spp.	1		.5	1	3.0	0.8	75	0.7
						2.5	0.6	75	0.5
D	Ely in	3	4	1	4				
	Car spp.	7	2		1	12.0	3.0	100	3.0
	Jun spp.	5	1		3	10.0	2.5	75	2.2
	Des ca	1	5		.5	9.0	2.3	75	2.0
	Bro pu		4			6.5	1.6	75	1.4
						4.0	1.0	25	0.5
Eb	Feathermoss	4	5	5		14.0	3.5	75	3.0

NOTE: Species with pi< 0.5: Cer ar, Pot gr, Hed ma, Arn co, Pol pu, Vio ad, Vic am, Val se, Epi an, Pol vi, Pen pr, Eri spp., Gen spp., Luz pa, Cal ru, Poa spp., Bro in

APPENDIX S

PLOT DATA FOR FORAGE TYPE: HAIR GRASS GRASSLAND

Plot No.	3	H-40
Forest Cover Type		
Parent Material	Mb / RT	Pv / Rrs
Elevation (metres)	1405	1650
Degrees Slope	-	3
Aspect	-	NE
Date	26/06	10/08

Biomass (kg/ha)

Grass	718.0
Forbs	1056.0
Browse	

Species	Percent Cover		Sum	$\bar{X}$	%f	pi
C Mer pa	2	22	24.0	12.0	100	12.0
Tha ve	6	15	21.0	10.5	100	10.5
Ach mi	6	7	13.0	6.5	100	6.5
Pot di	2	11	13.0	6.5	100	6.5
Del gl		14	14.0	7.0	50	4.9
Gal bo	3	4	7.0	3.5	100	3.5
Vic am	.5	4	4.5	2.3	100	2.3
Pol pu		5	5.0	2.5	50	1.8
Ast ci	3		3.0	1.5	50	1.1
Fra vi	2		2.0	1.0	50	0.7
Pot gr	2		2.0	1.0	50	0.7
Pen spp.	2		2.0	1.0	50	0.7
Gue tr	2		2.0	1.0	50	0.7
D Des ca	8	24	32.0	16.0	100	16.0
Ely in	8	1	9.0	4.5	100	4.5
Agr su	2	5	7.0	3.5	100	3.5
Agr da		8	8.0	4.0	50	2.8
Car spp.	3		3.0	1.5	50	1.1
Poa spp.		2	2.0	1.0	50	0.7

NOTE: Species with pi<0.5: Cer ar, Lat oc, Ane mu, Epi an, Rum spp., Gue ri, Bro pu.

APPENDIX T

PLOT DATA FOR FORAGE TYPE: PASTURE SAGE - JUNE GRASS (61)

Plot No.		28	103	104	N-23				
Forest Cover Type		Ah	Ah	Ah	Ah				
Parent Material		Fv/Rrs	Fv/Rrs	Fv/Rrs	Rsr				
Elevation (Metres)		1520	1500	1440	1720				
Degrees Slope		29	31	25	13				
Aspect		S	SW	SE	SW				
Date		10/06	26/07	26/07	09/08				
Biomass (kg/ha)									
Grass		254.0	444.0	468.0	504.0				
Forbs		382.0	562.0	804.0	426.0				
Browse									
Species		Percent Cover				Sum	$\bar{X}$	%f	pi
B2b	Art fr	25	5	23	40	93.0	23.3	100	23.3
	Ros ac	15	15			30.0	7.5	50	5.3
	Sym al	5	8			13.0	3.3	50	2.3
	Pot fr	10	1			11.0	2.8	50	2.0
C	Oxy ca	18	.5	5	15	38.5	9.6	100	9.6
	Gal bo	2	2	6		10.0	2.5	75	2.2
	Ant ni		11	.5		11.5	2.9	50	2.1
	Fra vi	1	4	3		8.0	2.0	75	1.7
	Com pa	1	1	.5	3	5.5	1.4	100	1.4
	Asr. st	4		4		8.0	2.0	50	1.4
	Cam ro		2	2	1	5.0	1.3	75	1.1
	Gen am		.5	3	1	4.5	1.1	75	1.0
	All ce		1	.5	2	3.5	0.9	75	0.8
	And sa	1	1	1		3.0	0.8	75	0.7
	Eri co		2		2	4.0	1.0	50	0.7
	Ane mu		2	1		3.0	0.8	50	0.6
D	Fes sa		.5	2	8	10.5	2.6	75	2.3
	Koe cr		1	1	8	10.0	2.5	75	2.2
	Car spp.	1		1	5	7.0	1.8	75	1.6
	Agr da	1	1	.5	3	5.5	1.4	100	1.4
Eb	Feathermoss	.5			5	5.5	1.4	50	0.7

NOTE: Species with pi<0.5: She ca, Ant spp., Ach mi, Gal ar, Sal st, Vic am, Sis mo, Sen ca, Ago au, Art mi, Hed al, Ast ci, Car ar, Tar of, Pot spp., Ane pa, Bro pu, Cal ru, Ely in, Agr su

NOTE: Asr = Astragalus

APPENDIX U

PLOT DATA FOR FORAGE TYPE: KOOTNEY PLAINS GRASSLAND (G2)

Plot No.	76	H-29
Forest Cover Type	⅄⅄	⅄⅄
Parent Material	Ft	Mv//C / Rt
Elevation (metres)	1380	1440
Degrees Slope	-	-
Aspect	-	-
Date	26/06	09/08

Biomass (kg/ha)	
Grass	208.0
Forbs	662.0
Browse	

Species		Percent Cover		Sum	$\bar{X}$	%f	pi
C	Ant ni	30	2	32.0	16.0	100	16.0
	Asr al	15	7	22.0	11.0	100	11.0
	Pot gr	2		2.0	1.0	50	0.7
D	Agr da	1	2	3.0	1.5	100	1.5
	Cal pu		4	4.0	2.0	50	1.4
	Koe cr	1	1	2.0	1.0	50	0.7
El	Reindeer lichen	.5	.5	1.0	0.5	100	0.5

NOTE: Species with pi<0.5: Pot fr, Pop tr, Ros ac, Ane mu, Sen ca, And se, Cam ro, Oxy ca, Eri spp., Bro pu, Car spp.

NOTE: Asr = Astragalus

APPENDIX V

PLOT DATA FOR FORAGE TYPE: COMMON BEARBERRY - LATE YELLOW LOCOWEED (G3)

Plot No.	105	110	111	112
Forest Cover Type	Ju	Ju	Ju	Ju
Parent Material	Pv / Rrs	Pv / Rrs	Pv / Rrs	Pv / Rrs
Elevation (Metres)	1410	1220	1220	1350
Degrees Slope	14	21	13	24
Aspect	S	S	S	S
Date	26/07	10/09	10/09	10/09
Biomass (kg/ha)				
Grass	326.0	114.0	40.0	64.0
Forbs	230.0	172.0	166.0	150.0
Browse				

Species		Percent Cover				Sum	$\bar{X}$	%f	pi
B2a	She ca	6	1	8	10	25.0	6.3	100	6.3
	Pot fr	2	2	3		7.0	1.8	75	1.6
	Pic gl	5		3		8.0	2.0	50	1.4
	Jun co				5	5.0	1.3	25	0.7
B2b	Arc uv	10	30	65	60	165.0	41.3	100	41.3
	Jun ho	18	3	4	4	29.0	7.3	100	7.3
	Pot fr		20	12		32.0	8.0	50	5.7
	Ros ac		10	5	10	25.0	6.3	75	5.5
	Jun co	2	8	2	4	16.0	4.0	100	4.0
	She ca		1	5	2	8.0	2.0	75	1.7
C	Hed ma	4	2	2	4	12.0	3.0	100	3.0
	Fra vi	7	1	.5	2	10.5	2.6	100	2.6
	Oxy ca	.5	2	1	5	8.5	2.1	100	2.1
	Gal bo	1	2	2	1	6.0	1.5	100	1.5
	Ant ni	4	.5	.5		5.0	1.3	75	1.1
	Ast ci		1	1	2	4.0	1.0	75	0.9
	Ane mu	.5	1	1	.5	3.0	0.8	100	0.8
	Zyg el	.5	2	.5		3.0	0.8	75	0.7
D	Bro pu	1	.5	.5	.5	2.5	0.6	100	0.6

NOTE: Species with pi $<$ 0.5: Pop tr, Ast la, Ast co, Rhi cr, Ago au, Asr st, Sen ca, Lil ph, Gen am, Epi an, Com pa, Vic am, Sis mo, Cam ro, Car spp., Ely in, Cal pu, Poa spp., Agr da, Fes sa

NOTE: Asr = Astragalus

APPENDIX W

PLOT DATA FOR FORAGE TYPE ALPINE FORAGE TYPE (G6)

Plot No.		116	H-37	117	H-31
Forest Cover Type					
Parent Material		R / RTF	Rrs	Pv / RTF	Rrs
Elevation (metres)		2040	2100	2000	2120
Degrees Slope		27	30	7	14
Aspect		SW	S	N	SW
Date		06/08	10/08	06/08	10/08
Biomass (kg/ha):					
Grass		558.0	10.0	94.0	32.0
Forbs		492.0	38.0	308.0	56.0
Browse					
Species			Percent Cover		
B2b	Dry ho		10.0	70.0	35.0
	Sal ni		10.0	20.0	8.0
	Pot fr	5.0			0.5
	Pic en			5.0	
	Sal spp.			3.0	
C	Pol vi	3.0	2.0	6.0	0.5
	Sol spp.		2.0	11.0	
	Epi an	6.0			
	Zyg el	5.0		3.0	
	Hed ma		5.0		
	Arn al	3.0	0.5	1.0	1.0
	Oxy spp.	4.0		1.0	
	Sax tr	2.0			2.0
	Gal bo	2.0			
	Oxy ca	2.0			
	Gen pr	0.5	0.5		
	Gen am		0.5	2.0	0.5
	Sen pa		1.0	3.0	
	Pot ni			1.0	0.5
	Pot di			1.0	0.5
	Ach mi		0.5	2.0	
	Oxy po				1.0
	Sme ca				0.5
	Ant ni				0.5
	Ane pa				0.5
	And ch				1.0
	Fra vi		0.5		
	Ast spp.		1.0		
	Ago au		1.0		
	Ane mu		0.5		
	Ped ca			1.0	
	Del gl			1.0	
D	Kob be	22.0		4.0	0.5
	Ely in	9.0		3.0	
	Poa spp.	4.0	0.5		
	Cal spp.				1.0
	Fes spp.	0.5			0.5
Eb	Feathermoss	10.0		66.0	0.5
El	Reindeer lichen	2.0		5.0	0.5

APPENDIX X

PLOT DATA FOR FORAGE TYPE: CLEARCUT (D1)

Plot No.	122	127
Forest Cover Type	CC	CC
Parent Material	Mvb / Rmi	Pv / Rtr
Elevation (Metres)	1640	1460
Degrees Slope	-	8
Aspect	-	S
Date	20/08	21/08
Biomass (kg/ha)		
Grass	436.0	256.0
Forbs	500.0	780.0
Browse	0.0	0.0

Species		Percent Cover		Sum	$\bar{X}$	%f	pi
B2a	Ros ac		3	3.0	1.5	50	1.1
B2b	Lin bo	1	1	2.0	1.0	100	1.0
	Rub st	2		2.0	1.0	50	0.7
C	Epi an	8	6	14.0	7.0	100	7.0
	Pet pa	3	4	7.0	3.5	100	3.5
	Mer pa		6	6.0	3.0	50	2.1
	Ast la		5	5.0	2.5	50	1.8
	Tar of	2	.5	2.5	1.3	100	1.3
	Ach mi	1	.5	1.5	0.8	100	0.8
	Mit nu	.5	1	1.5	0.8	100	0.8
	Ast co		2	2.0	1.0	50	0.7
	Cas mi		2	2.0	1.0	50	0.7
	Gen am		2	2.0	1.0	50	0.7
D	Ely in	3	2	5.0	2.5	100	2.5
	Car spp.	3	.5	3.5	1.8	100	1.8
	Cal pu	5		5.0	2.5	50	1.8
	Des ca	3		3.0	1.5	50	1.1
Eb	Feathermoss	7	20	27.0	13.5	100	13.5

NOTE: Species with pi < 0.5: Sal spp., She ca, Pin co, Rub ac, Sol spp., Cor ca, Pol vi, Fra vi, Ago au, Sen pa, Vic am, Lat oc, Zyg el, Pel spp.

APPENDIX Y

SPECIES LIST BY VEGETATION LAYER

Layer A

Common Name	Latin Name	Abbreviation
* Alpine Fir	*Abies lasiocarpa*	Abi la
Balsam Poplar	*Populus balsamifera*	Pop ba
Black Spruce	*Picea mariana*	Pic ma
Engelmann Spruce	*Picea engelmannii*	Pic en
Lodgepole Pine	*Pinus contorta*	Pin co
Tamarack	*Larix laricina*	Lar la
* Trembling Aspen	*Populus tremuloides*	Pop tr
White Spruce	*Picea glauca*	Pic gl

Layer B

Blueberry	*Vaccinium myrtilloides*	Vac my
Bog Cranberry	*Vaccinium vitis-idaea*	Vac vi
Bracted Honeysuckle	*Lonicera involucrata*	Lon in
Bristly Black Currant	*Ribes lacustre*	Rib la
Canadian Buffalo-berry	*Shepherdia canadensis*	She ca
Common Bearberry	*Arctostaphylos uva-ursi*	Arc uv
Creeping Juniper	*Juniperus horizontalis*	Jun ho
Currant	*Ribes* species	Rib spp.
Dwarf Bilberry	*Vaccinium caespitosum*	Vac ca
* Dwarf Birch	*Betula glandulosa*	Bet gl
Green Alder	*Alnus crispa*	Aln cr
Ground Juniper	*Juniperus communis*	Jun co
Grouse-berry	*Vaccinium scoparium*	Vac sc
Labrador Tea	*Ledum groenlandicum*	Led gr
Limber Pine	*Pinus flexilis*	Pin fl
* Low-bush Cranberry	*Viburnum edule*	Vib ed
Menziesia	*Menziesia glabella*	Men gl
- Mountain Ash	*Sorbus scopulina*	Sor sc
- Mountain Laurel	*Kalmia polifolia*	Kal po
* Prickly Rose	*Rosa acicularis*	Ros ac
* Saskatoon-berry	*Amelanchier alnifolia*	Ame al
Shrubby Cinquefoil	*Potentilla fruticosa*	Pot fr
Snowberry	*Symphoricarpos albus*	Sym al

NOTE: Species marked with an *are considered to be palatable browse species

Layer B

Common Name	Latin Name	Abbreviation
Tall Bilberry	*Vaccinium membranaceum*	Vac me
Twinflower	*Linnaea borealis*	Lin bo
Twining Honeysuckle	*Lonicera dioica*	Lon di
White Dryad	*Dryas hookeriana*	Dry ho
White-flowered Rhododendron	*Rhododendron albiflorum*	Rho al
White Meadowsweet	*Spiraea lucida*	Spi lu
White Mountain Heather	*Cassiope tetragona*	Cas te
Wild Black Currant	*Ribes americanum*	Rib am
Wild Red Currant	*Ribes triste*	Rib tr
*Willow	*Salix* species	Sal spp.
Willow	*Salix nivalis*	Sal ni
Yellow Dryad	*Dryas drummondii*	Dry dr
Yellow Heather	*Phyllodoce glanduliflora*	Phy gl

Layer C

Anemone	*Anemone parviflora*	Ane pa
Arnica	*Arnica alpina*	Arn al
Arnica	*Arnica cordifolia*	Arn co
Bastard Toad-flax	*Comandra pallida*	Com pa
Bastard Toad-flax	*Geocaulon lividum*	Geo li
Beard-tongue	*Penstemon* species	Pen spp.
Bishop's cap	*Mitella nuda*	Mit nu
Bistort	*Polygonum viviparum*	Pl vi
Bluebell	*Campanula rotundifolia*	Cam ro
Blue Columbine	*Aquilegia brevistyla*	Aqu br
Blue-eyed Grass	*Sisyrinchium montanum*	Sis mo
Blunt-leaved Orchid	*Habenaria obtusata*	Hab ob
Bog Orchid	*Habenaria* species	Hab spp.
Bronze-bells	*Stenanthium occidentale*	Ste oc
Bunchberry	*Cornus canadensis*	Cor ca
Buttercup	*Ranunculus species*	Ran spp.
Cinquefoil	*Potentilla diversifolia*	Pot di
Cinquefoil	*Potentilla nivea*	Pot ni
Cinquefoil	*Potentilla* species	Pot spp.
Cloudberry	*Rubus chamemorus*	Rub ch
Common Dandelion	*Taraxacum officinale*	Tar of
Common Horsetail	*Equisetum arvense*	Equ ar
Common Pink Wintergreen	*Pyrola asarifolia*	Pyr as
Common Red Paintbrush	*Castilleja miniata*	Cas mi
Common Yarrow	*Achillea millefolium*	Ach mi

Layer C

Common Name	Latin Name	Abbreviation
Cow Parsnip	*Heracleum lanatum*	Her la
Cut-leaved Anemone	*Anemone multifida*	Ane mu
Dewberry	*Rubus pubescens*	Rub pu
Dock	*Rumex* species	Rum spp.
Dwarf Raspberry	*Rubus acaulis*	Rub ac
Early Blue Violet	*Viola adunca*	Vio ad
Fairy Candelabra	*Androsace septentrionalis*	And se
False Dandelion	*Agoseris glauca*	Ago gl
False Dandelion	*Agoseris aurantiaca*	Ago au
False Solomon's-seal	*Smilacina racemosa*	Smi ra
Felwort	*Gentianella amarella*	Gen am
Fireweed	*Epilobium angustifolium*	Epi an
Fleabane	*Erigeron species*	Eri spp.
Fleabane	*Erigeron compositus*	Eri co
Forget-me-not	*Myostis alpestris*	Myo al
Gaillardia	*Gaillardia aristata*	Gai ar
Gentian	*Gentiana prostrata*	Gen pr
Gentian	*Gentiana* species	Gen spp.
Geranium	*Geranium richardsonii*	Ger ri
Goldenrod	*Solidago* species	Sol spp.
Goldthread	*Coptis triflora*	Cop tr
Graceful Cinquefoil	*Potentilla gracilis*	Pot gr
Grass-of-Parnassus	*Parnassia palustris*	Par pa
Grass-of-Parnassus	*Parnassia fimbriata*	Par fi
Greenish-flowered Wintergreen	*Pyrola virens*	Pyr vi
Ground Cedar	*Lycopodium complanatum*	Lyc co
Ground Pine	*Lycopodium obscurum*	Lyc ob
Groundsel	*Senecio pauciflorus*	Gen pa
Groundsel	*Senecio triangularis*	Gen tr
Heart-leaved Twayblade	*Listera cordata*	Lis co
Hedysarum	*Hedysarum alpinum*	Hed al
Hedysarum	*Hedysarum mackenzii*	Hed ma
Hedysarum	*Hedysarum sulphurescens*	Hed su
Horsetail	*Equisetum scirpoides*	Equ sc
Indian Pipe	*Monotropa uniflora*	Mon un
Jacob's-ladder	*Polemonium pulcherrimum*	Pol pu
Late Yellow Loco-weed	*Oxytropis campestris*	Oxy ca
Lindley's Aster	*Aster ciliolatus*	Ast ci
Loco-weed	*Oxytropis podocarpa*	Oxy po
Loco-weed	*Oxytropis* species	Oxy spp.
Lousewort	*Pedicularis bracteosa*	Ped br
Lousewort	*Pedicularis capitata*	Ped ca
Marsh Cinquefoil	*Potentilla palustris*	Pot pa
Milk Vetch	*Astragalus alpinus*	Asr al

Layer C

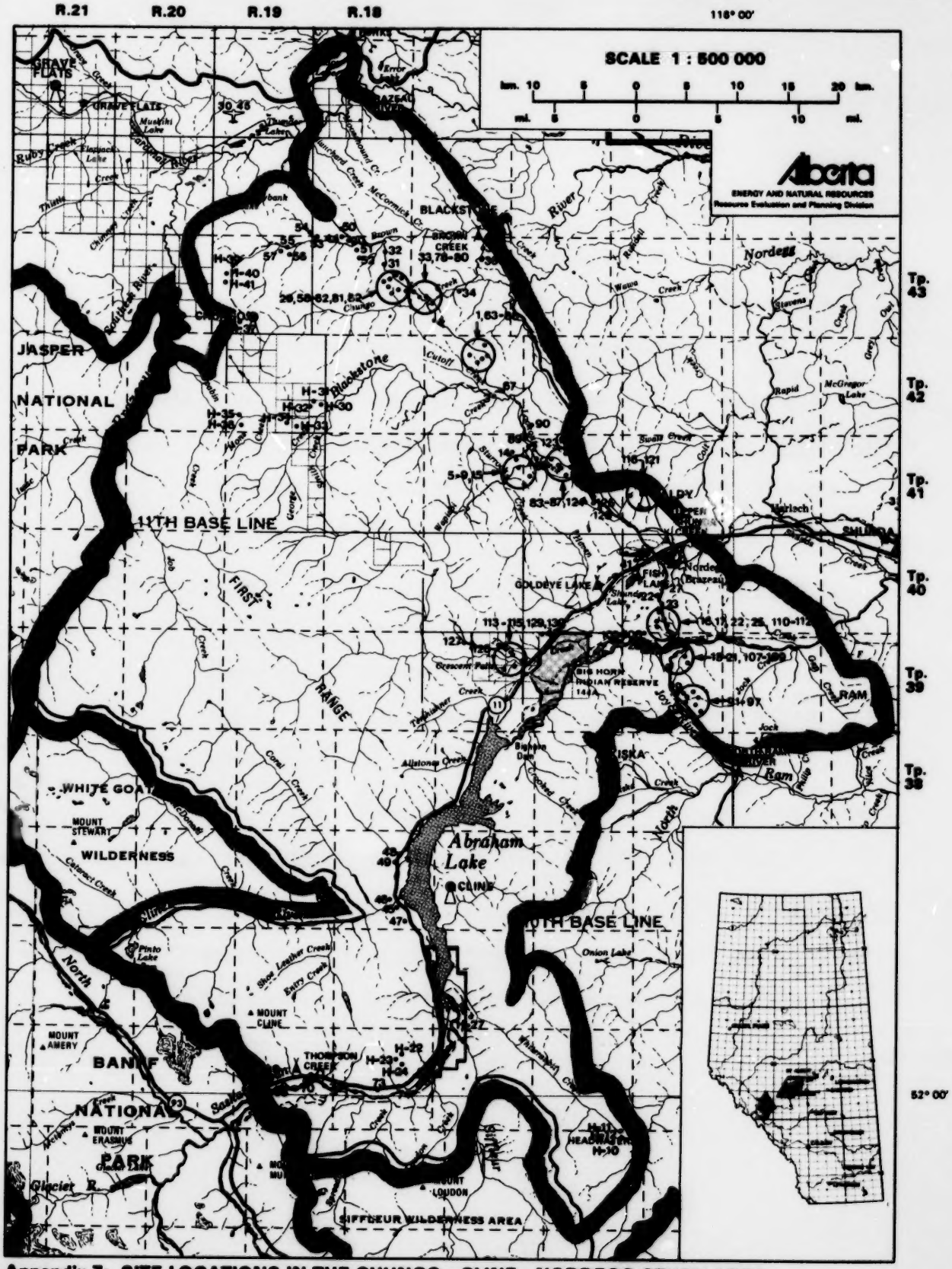
Common Name	Latin Name	Abbreviation
Milk Vetch	*Astragalus striatus*	Asr st
Mouse-ear Chickweed	*Cerastium arvense*	Cer ar
Nodding Onion	*Allium cernum*	All ce
Northern Bedstraw	*Galium boreale*	Gal bo
Old Man's Whiskers	*Geum triflorum*	Geu tr
One-sided Wintregreen	*Pyrola secunda*	Pyr se
Pale Coral-root	*Corallorhiza trifida*	Cor tr
Palmate-leaved Coltsfoot	*Petasites palmatus*	Pet pa
Pea Vine	*Lathyrus ochroleucus*	Lat oc
Prairie Groundsel	*Senecio canus*	Sen ca
Purple Avens	*Geum rivale*	Geu ri
Pussy-toes	*Antennaria nitida*	Ant ni
Raspberry	*Rubus pedatus*	Rub pe
Sagebrush	*Artemisia michauxiana*	Art mi
Saxifrage	*Saxifraga tricuspidata*	Sax tr
Showy Aster	*Aster conspicuus*	Ast co
Sibbaldia	*Sibbaldia procumbens*	Sib pr
Slender Blue Beard*tongue	*Penstemon procerus*	Pen pr
Small Bog Cranberry	*Oxycoccus microcarpus*	Oxy mi
Smelowskia	*Smelowskia calycina*	Sme ca
Smooth Aster	*Aster laevis*	Ast la
Speedwell	*Veronica alpina*	Ver al
Star-flowered Solomon's seal	*Smilacina stellata*	Smi st
Stiff Club-moss	*Lycopodium annotinum*	Lyc an
Sweet-flowered Androsace	*Androsace chamaejasme*	And ch
Tall larkspur	*Delphinium glaucum*	Del gl
Three-leaved Solomon's-seal	*Smilacina trifolia*	Smi tr
Twisted-stalk	*Streptopus amplexifolius*	Str am
Valeriana	*Valeriana septentrionalis*	Val se
Veiny Meadue rue	*Thalictrum venulosum*	Tha ve
Venus'-slipper	*Calypso bulbosa*	Cal bu
Violet	*Viola renifolia*	Vio re
Western Wood Lily	*Lilium philadelphicum*	Lil ph
White Camas	*Zygadenus elegans*	Zyg el
Wild Lily-of-the-Valley	*Maianthemum canadense*	Mai ca
Wild Strawberry	*Fragaria virginiana*	Fra vi
Wild Vetch	*Vicia americana*	Vic am
Wood Anemone	*Anemone quinquefolia*	Lik ph
Yellow Rattle	*Rhinanthus crista-galli*	Rhi cr

Layer D

Awnless Brome	*Bromus inermis*	Bro in

Layer D

Common Name	Latin Name	Abbreviation
Bearded Wheat Grass	*Agropyron subsecundum*	Agr su
Bluegrass	*Poa* species	Poa spp.
Brome Grass	*Bromus* species	Bro spp.
Fescue	*Festuca brachyphylla*	Fes br
Fescue	*Festuca saximontana*	Fes sa
Fescue	*Festuca* species	Fes spp.
Hairy Wild Rye	*Elymus innovatus*	Ely in
June Grass	*Koelaria cristata*	Koe cr
Kobresia	*Kobresia bellardii*	Kob be
Marsh Reed Grass	*Calamagrostis canadensis*	Cal ca
Northern Awnless Brome	*Bromus pumpellianus*	Bro pu
Northern Wheat Grass	*Agropyron dasystachym*	Agr da
Pine Grass	*Calamagrostis rubescens*	Cal ru
Purple Reed Grass	*Calamagrostis purpurascens*	Cal pu
Reed Grass	*Calamagrostis neglecta*	Cal ne
Rice Grass	*Oryzopsis pungens*	Ory pu
Rice Grass	*Oryzopsis* species	Ory spp.
Rush	*Juncus* species	Jun spp.
Sedge	*Carex* species	Car spp.
Tufted Hair Grass	*Deschampsia caespitosa*	Des ca
Wood Rush	*Luzula parviflora*	Luz pa



Appendix Z: SITE LOCATIONS IN THE CHUNGO - CLINE - NORDEGG STUDY AREA

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